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Introduction

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Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **3918**

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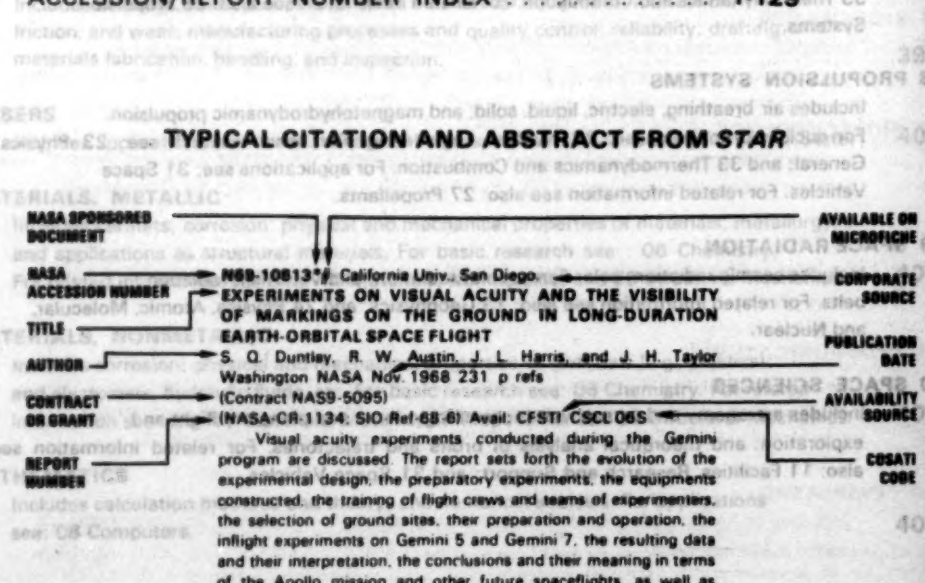
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EXPERIMENTS ON VISUAL ACUITY AND THE VISIBILITY OF MARKINGS ON THE GROUND IN LONG-DURATION EARTH-ORBITAL SPACE FLIGHT
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AUTHOR
S. Q. Duntley, R. W. Austin, J. L. Harris, and J. H. Taylor
Washington NASA Nov. 1968 231 p refs
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(NASA-CR-1134; SIO-Ref-68-6) Avail: CFSTI CSCL 06S
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Visual acuity experiments conducted during the Gemini program are discussed. The report sets forth the evolution of the experimental design, the preparatory experiments, the equipments constructed, the training of flight crews and teams of experimenters, the selection of ground sites, their preparation and operation, the inflight experiments on Gemini 5 and Gemini 7, the resulting data and their interpretation, the conclusions and their meaning in terms of the Apollo mission and other future spaceflights, as well as certain suggestions for future inflight tests of human visual capabilities in space.
Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N69-36218*# Techtran Corp., Glen Burnie, Md.

THE EFFECT OF SEPARATIONS AT THE LEADING EDGE ON THE AERODYNAMIC FEATURES OF WINGS [INFLUENCE DES DECOLLEMENTS AU BORD D'ATTAQUE SUR LES CARACTERISTIQUES AERODYNAMIQUES DES VOILURES]

Ville Washington NASA Sep. 1969 42 p refs Transl. into ENGLISH from Colloq. Aerodynamique Appl. (France), Nov. 1967 (Contract NASw-1695)

(NASA-TT-F-12546) Avail: CFSTI CSCL 01A

Study of the evolution of wing lift as a function of incidence has shown the existence of separations appearing at the leading edge, the trailing edge or at both simultaneously. The purpose of this review is to specify the separation phenomena which are produced along the leading edge. In the first part we approach these problems for bidimensional flow; the existence of reduced parameters characteristic of the influence of incidence, of the Reynolds test number and of the geometrical form of the profile on the nature and amount of separation is shown. In the second part are indicated the possibilities of generalizing from these results to wings tested tridimensionally. To conclude this review, we analyzed the influence of these results on the interpretation of wind tunnel tests. Author

N69-36309# National Aeronautical Establishment, Ottawa (Ontario).

THE LIFT ON A TWO-DIMENSIONAL AUGMENTOR WING

Y. Y. Chan Apr. 1969 44 p refs

(NRC-10819; LR-523) Avail: CFSTI

The performance of an augmentor wing has been examined with a simplified model that consists of a thin airfoil with a jet-augmented flap and a sink located at the hinge of the flap. The analysis is based on a small disturbance theory. The results for the basic configuration, namely the airfoil with a jet-augmented flap, agree very well with those obtained by other authors. It shows that the lift on the airfoil can be increased appreciably with a jet-augmented flap. Suction on the upper surface of the airfoil can also induce additional lift on the system. This induced lift becomes more efficient as the suction slot moves towards the trailing edge. However, the lift decreases slightly as the jet momentum flux increases and the jet becomes more stiff. Author

N69-36323# Institut Franco-Allemand de Recherches, St. Louis (France).

ON THE EFFECT OF CIRCULAR RIMS ON PROJECTILES NOT STABILIZED BY SPIN AT INCOMPRESSIBLE SUBSONICS [UEBER DIE WIRKUNG VON STAURAENDERN BEI NICHT DRALLSTABILISIERTEN GESCHOSSEN IM INKOMPRESSIBLEN UNTERSCHALL]

R. Ramshorn 13 May 1968 40 p refs In GERMAN; FRENCH summary

(ISL-T-12/68) Avail: CFSTI

The results of extensive static and dynamic experiments in a subsonic wind tunnel concerning the use of circular rims to achieve aerodynamic stabilization through the resulting stagnation pressure are summarized. Projectiles with and without stabilization fins were tested. Three different stabilization modes are discussed in detail: stabilization by fixed rim in addition to fins, by adjustable rim without fins, and with the position of one rim varied while the other rim remains fixed at the projectile's aft without fins. Rim stabilization at supersonic velocities is briefly discussed. Transl. by K.W.

N69-36331*# National Aeronautics and Space Administration, Washington, D. C.

SELF-INDUCED VIBRATIONS OF AXIAL-COMPRESSOR BLADES

I. M. Movahovich *In its* Invest. of Vibration and Stability of Aircraft Eng. Components Aug. 1969 p 71-82 refs (See N69-36326 21-02)

Avail: CFSTI CSCL 01A

Amplitude frequency equations of axial compression blades are used to analyze self induced vibrations. The motion of each blade is considered separately by replacing the effect of neighboring blades with an external periodic force, the frequency of which is equal to the frequency of vibrations of the entire blading. The problem is thus reduced to forced vibrations of a self-excited system with one degree of freedom. This scheme makes it possible to explain the scatter in blade vibration stresses of the same blading set and the phase differences between the blades. G.G.

N69-36380# Institut Franco-Allemand de Recherches, St. Louis (France).

IMPROVED FORMS OF AN ARROW-SHAPED PROJECTILE [FORMES AMELIOREES D'UN PROJECTILE FLECHE]

M. Giraud and G. Simon 30 Apr. 1968 50 p refs In FRENCH; GERMAN summary

(ISL-T-8/68) Avail: CFSTI

Characteristic data are developed for a wing-stabilized elongated projectile whose wings protrude according to an area distribution law that covers the distance from the tip to ground. Basic calculations for this projectile are simple if the wings possess a subsonic leading edge. Projectile shape is modified by step wise inclusion of flying stability and atmospheric resistance effects on

impact characteristics. The elected form "5" has a high stability because its angle of attack at 130 m distance from the muzzle is always smaller than 0.5° and the resistance coefficient is reduced from 0.25 to 0.21. The characteristic data for the new projectile are: (1) caliber length 15.4; (2) largest diameter of the projectile body 13 mm; (3) largest diameter of the controling surfaces 24.4 mm; (4) mass 50 g (Dural) and 135 g (steel); and (5) operational velocity 1 km/s. Transl. by G.G.

N69-36479# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SUPERSONIC REACTION PROFILE FOR THE ROTOR BLADE OF THE LAST STEP OF A POWERFUL TURBINE

G. A. Sokolovskii et al 4 Mar. 1969 16 p refs Transl. into ENGLISH from Energ. Mashinostr. (USSR), no. 5, 1967, p 14–19
(AD-688732; FTD-MT-24-455-68) Avail: CFSTI CSCL 10/1

In turbine blades 780–1050 mm long, it is established that the Mach number at the exit of the turbine blades increases at a higher rate than the increase in the inlet angle. Therefore, the inverse curvature of the profile center line can be realized only near the peripheral section. At the blade cross-section with the transition from a concave to a convex surface, the concave blade should have an oblique section. The experimental study indicates that the plane surface profile can be used in steam turbine blades to provide a transition to an inverse concavity. Losses of profiles constructed by this method are 3.5 percent. Author (TAB)

N69-36493# National Aerospace Lab., Tokyo (Japan).

MEASUREMENT OF DYNAMIC STABILITY DERIVATIVES OF CONES AND DELTA-WINGS AT HIGH SPEED

Mitsunori Yanagizawa 1969 21 p refs In JAPANESE; ENGLISH summary
(NAL-TR-172) Avail: CFSTI

The aerodynamic stability derivatives of cones having semivertex angles from 10 degrees to 90 degrees and a delta-wing were measured by oscillating the models in pitch around zero angle of attack at various pitching axis locations at Mach numbers from 0.4 to 3.0, employing the free oscillation technique for half models, and the results were compared with the theoretical predictions. The reduced frequency range was from 0.015 to 0.06 and the corresponding Reynolds number based on the base diameter varied from 0.32×10^6 to 0.66×10^6 at subsonic and transonic regions and from 2.36×10^6 to 3.0×10^6 at supersonic region. The experimental results, for the cones having semivertex angles of 10 degrees and 20 degrees, agreed quite well with those of the potential theories. With increases of the semivertex angles of cones having the oscillating axis just around the mid-point on the cone axis, the models were statically stable and correspondingly the damping forces were decreased but still remained in the stable region. For the delta-wing, the experimental values agreed well with the theoretical values in both the subsonic and supersonic regions, but they showed considerable deviation in the transonic region. Author

N69-36834# Space Sciences, Inc., Waltham, Mass.

HYPERSONIC CONE DRAG AT HIGH ALTITUDE Final Report

Pung Nien Hu and Harold Grad May 1969 29 p refs
(Contract N00014-68-C-0130)
(AD-688205; SSI-381) Avail: CFSTI CSCL 20/4

The near free molecular flow of a slender cone at zero incidence in a hypersonic stream is studied. It is assumed that the cone surface is diffusely reflecting and has a temperature comparable to the free stream temperature. The nonlinear Boltzmann equation for hard sphere molecules is used and an exact expression for the drag is obtained. The result shows that the drag is reduced from its free molecular value. Author (TAB)

N69-36899*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

BODIES OF REVOLUTION HAVING MINIMUM TOTAL DRAG IN HYPERSONIC FLOW

Waldo I. Oehman and Sylvia A. Wallace Washington Sep. 1968 53 p
(NASA-TN-D-5438) Avail: CFSTI CSCL 01A

The calculus of variations was used to study minimum-drag bodies in hypersonic flow. Newton's formula for pressure drag was assumed, and viscous drag was formulated by use of a variable local skin-friction coefficient. Numerical results are included to assess the effect of the viscous drag for bodies having either given length and base height or given length and volume. The computer program is included for convenience. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N69-36013# Congress. House. Committee on Science and Astronautics.

AERONAUTICAL RESEARCH AND DEVELOPMENT

Washington GPO 1968 375 p Hearings before Subcomm. on Advan. Res. and Technol., 90th Congr., 2d Sess., no. 10, 24–26 Sep., 30 Sep., 1–3 Oct. 1968
Avail: Subcomm. on Advan. Res. and Technol.

A transcript of the proceedings of special Congressional subcommittee hearings designed to identify the priorities needed in aeronautical research and development is presented. Testimony covered numerous broad aspects of the subject: civil and military aviation technology and problems; airport congestion, air traffic control, and ground transportation; aircraft technology, including the status of supersonic, vertical takeoff and short takeoff aircraft; noise research; and the governmental role in the problem. L.B.H.

N69-36097# Weapons Research Establishment, Adelaide (Australia).

WESSEX HELICOPTER/SONAR DYNAMICS STUDY Initial Report

T. J. Packer Jan. 1969 21 p ref
(WRE-TN-SAD-216) Avail: CFSTI

This initial report gives a survey of the history of the project. Proposals for mathematical model studies are outlined, together with a description of the studies conducted to February 1968 and including flight and ground trials at the R.A.N. air station at Nowra N.S.W. The report concludes with an assessment of the present situation and future work necessary to complete the objectives of the studies. Author

N69-36104# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

PREDICTION OF ROTOR INSTABILITY AT HIGH FORWARD SPEEDS. VOLUME 3: STALL FLUTTER Final Report

Franklin O. Carta and Charles F. Niebanck Ft. Eustis, Va. Army Aviation Mater. Labs. Feb. 1969 103 p refs
(Contract DA-44-177-AMC-332(T))
(AD-687322; SER-50469-Vol-3; USAAVLABS-TR-68-18C) Avail: CFSTI CSCL 1/3

The analytical study in this volume was carried out to determine the susceptibility of helicopter rotor blades to a stall flutter instability. This analysis was based on the use of unsteady aerodynamic data previously obtained for an NACA 0012 airfoil oscillating in pitch about its quarter-chord over a wide range of values of incidence angle, oscillatory frequency, amplitude of motion, and free-stream velocity. These data were originally available in the form of moment coefficient-incidence angle loops, and a twofold task was performed in carrying out this study. First, it was necessary to convert the moment coefficient data to an aerodynamic damping parameter form. This was accomplished by integrating the moment over one cycle of motion to yield the aerodynamic work per cycle, and this in turn was multiplied by appropriate conversion factors to produce the desired two-dimensional aerodynamic damping. Second, it was necessary to apply these two-dimensional results to a helicopter rotor to evaluate the weighted three-dimensional damping at each azimuth station, and to interpret the implications of any predicted region of instability. The stall flutter analysis was used in conjunction with the blade motion solution of volume 1 to provide flight condition boundaries for stall flutter intensity. Author (TAB)

N69-36105# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

PREDICTION OF ROTOR INSTABILITY AT HIGH FORWARD SPEEDS. VOLUME 4: TORSIONAL DIVERGENCE Final Report

Charles F. Niebanck and H. L. Elman Ft. Eustis, Va. Army Aviation Mater. Labs. Feb. 1969 129 p
(Contract DA-44-177-AMC-332(T))
(AD-687323; SER-50469-Vol-4; USAAVLABS-TR-68-18D) Avail: CFSTI CSCL 1/3

A simple energy balance method for determining static stability was used to evaluate rotor blade torsional divergence boundaries, and a set of blade design charts was generated. To compare the results of this simple analysis with a more refined method, and to investigate the effects of parameters not included in the simple method, other calculations were made with the extended normal mode transient analysis. One type of practical rotor blade operating boundary is defined by peak-to-peak torsional stress. The static torsional divergence stability boundary usually approximates this practical operating limit, as verified by the normal mode transient analysis calculations. This approximation is valid for an important number of blade parameters. Recommended preliminary design procedures, incorporating the charts generated for the volume are given for the rapid definition of blades with adequate torsional stiffness. Author (TAB)

N69-36258*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STATIC AND DYNAMIC STABILITY DERIVATIVES OF A MODEL OF A JET TRANSPORT EQUIPPED WITH EXTERNAL-FLOW JET-AUGMENTED FLAPS

Delma C. Freeman, Jr., Sue B. Grafton, and Richard D'Amato Washington Sep. 1969 52 p refs
(NASA-TN-D-5408) Avail: CFSTI CSCL 01C

A wind-tunnel investigation has been made to determine the static and dynamic stability derivatives of a model of a large jet transport equipped with external-flow jet-augmented flaps. The tests were conducted in the Langley full-scale tunnel, and a model powered by scale-model, compressed-air-driven turbofan engines was used. The results of the investigation showed that blowing on the flap system increased the lift curve slope, delayed the stall, and increased the maximum lift coefficient. The data also showed that all model configurations generally had static longitudinal stability over the test angle-of-attack range except those at the higher flap-deflection angles where the effects of power were destabilizing. The results also showed that the model had positive damping in pitch, roll, and yaw throughout the test angle-of-attack range up to and slightly beyond the stall for all test conditions. The application of power in the flap system resulted in appreciable increases in roll damping but produced essentially no effects in pitch and yaw damping. There were essentially no effects due to oscillation frequency on the damping derivatives. Author

N69-36287# National Science Foundation, Washington, D.C. Office of Economic and Manpower Studies.

R AND D IN THE AIRCRAFT AND MISSILES INDUSTRY, 1957–1968

John R. Chirichiello May 1969 25 p refs
(NSF-69-15) Avail: SOD $0.40

A detailed analysis of published research and development (R & D) statistics in the aircraft and missiles industries, the source of their funding, the manpower and the nationwide distribution of these activities is reported. The period, 1957–1968, is analyzed with comparisons made of industry structure, competition, diversification, and the changing markets. Data from personal interviews with company officials of 19 major American firms, trade associations, and Federal agencies are also summarized. Aircraft and missiles industries spending for R & D in 1967 was a record $5.6 billion, constituting 34% of all industrial spending for R & D and a 116% increase over the 1957 level of $2.6 billion. During that peak year, 27% of all R & D scientists and engineers in industry were employed in aircraft and missiles, and average salaries were an estimated $2,500 higher per man. Basic research, applied research, and technical development statistics are presented in terms of past activities, and trends for the future are described since overall cutbacks in Federal funding of aircraft and missiles R & D has occurred. M.H.E.

N69-36318*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

AN ANALYSIS OF THE DEVELOPMENT OF AVIATION MODELING IN THE 19th CENTURY

Yu. I. Navokshonov *In its* Trans. of the Tenth Sci. Conf. of The Inst. Of Hist. of Nat. Sci. and Tech. Sep. 1969 p 31–39 refs (See N69-36314 21-34)
Avail: CFSTI CSCL 01C

The article examines certain regularities in the evolution of physical models of flying apparatus with a fixed supporting plane during the 19th century. The calculations presented show that the lack of horizontal empennage often found in the 19th century led to static instability of the models. Author

N69-36326*# National Aeronautics and Space Administration, Washington, D.C.

INVESTIGATION OF VIBRATION AND STABILITY OF AIRCRAFT ENGINE COMPONENTS [ISSLEDOVANIYE VIBRATSII PROCHNOSTI DETALEY AVIADVIGATELEY]

G. S. Skubachevskiy ed. Aug. 1969 12 p refs Transl. into ENGLISH from Trans. Moscow Aviation Inst. (Moscow), no. 172, 1967
(NASA-TT-F-547) Avail: CFSTI CSCL 01C

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1. THE SHAPE OF THE ELASTIC CURVE OF A WEIGHTLESS ROTATING SHAFT CARRYING ECCENTRICALLY LOCATED POINT MASSES OR DISKS A. N. Ogurechnikov p 1–19 (See N69-36327 21-15)

2. THE OPTIMUM HYDRAULIC DAMPING AMOUNT FOR A TURBINE ROTOR K. A. Kryukov p 20–47 refs (See N69-36328 21-28)

3. DYNAMIC COMPLIANCES IN A SYSTEM WITH FRICTION V. M. Balepin p 48–52 refs (See N69-36329 21-15)

4. FORCED VIBRATIONS OF A FREE SHAFT WITH FRICTION Ye. A. Artemov p 53–70 refs (See N69-36330 21-15)

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8. COMPUTATION OF VIBRATIONS OF VARIABLE-THICKNESS DISKS BY THE RITZ METHOD A. V. Karpov p 82–88 refs (See N69-36332 21-32)

7. THE HYDROSTATIC BEARING AS A SOURCE OF VIBRATIONS G. A. Ivanov p 89–92 refs (See N69-36333 21-15)

8. STABILITY OF THREE-LAYER CYLINDRICAL SHELLS BEYOND THE ELASTIC LIMIT V. V. Serdyukov p 93–104 refs (See N69-36334 21-32)

9. THE APPLICATION OF CONFORMAL MAPPING TO PROBLEMS OF THE THEORY OF ELASTICITY V. G. Gorlov p 105–110 refs (See N69-36335 21-19)

10. STABILITY OF THREE-LAYER CYLINDRICAL SHELLS IN THE ELASTIC AND INELASTIC REGIONS I. A. Yefimov p 111–117 refs (See N69-36336 21-32)

N69-36341# College of Aeronautics, Cranfield (England). Dept. of Aircraft Design.

SOME EXPERIMENTS WITH FLUIDIC DEVICES IN AVIATION KEROSENE

A. F. Taylor Apr. 1969 17 p refs

(CoA-Note-AERO-176) Avail: CFSTI

The use of fluidic devices for aircraft fluid systems is explored. Tests were conducted at sea level on several devices both singly and in pairs in aviation kerosene. Reasonable results were obtained from the design models. E.H.W.

N69-36362# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF UNDERLYING SURFACE ON READINGS OF THE RVTD-A RADIO ALTIMETER

N. P. Kozhevnilov 31 Jan. 1969 22 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 1, 1968 p 49–55

(AD-688687; FTD-MT-24-427-68) Avail: CFSTI CSCL 1/4

The use of radio altimeters during aerial photography to determine flight altitude and for radio altimetry has a number of peculiarities connected with relief and character of the surface. Study of changes in the readings of a radio altimeter and the errors in determining flight altitude are very important for practical purposes. Author (TAB)

N69-36363# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ENGINEERING METHOD OF AERODYNAMIC DESIGN OF A GROUND-EFFECT VEHICLE WITH A DOUBLE-FLOW NOZZLE

F. L. Kalitievskii 30 Jan. 1969 11 p refs Transl. into ENGLISH from Samoletostroenie; Tekhn. Vozdushnogo Flota (USSR), no. 9, 1967 p 9–14

(AD-688143; FTD-HT-23-781-68) Avail: CFSTI CSCL 1/3

An engineering method is presented for calculating air-cushion vehicles (ACV) with two peripheral nozzles. The method is based on a study previously published by the author (On the aerodynamic calculation of air-cushion vehicles. Sb Samoletostroyeniye i tekhnika vozdushnogo flota, vyp. 6, Izd-vo KhGu, 1965). It is assumed that two peripheral jets (I and II) of an incompressible fluid join at the point K and that jet II contracts by a factor M after contacting the ground. Formulas were derived for the main characteristics of ACVs with two peripheral jets; from these characteristics the lifting capacity, the air flow rate, and the required power relative to the ACV geometry and its operating regimes can be determined. Author (TAB)

N69-36423# Air Force Logistics Command, Wright-Patterson AFB, Ohio. Operations Analysis Office

A ROUTINE AIR ELIGIBILITY CRITERION

Victor J. Presutti, Jr. May 1969 37 p refs

(AD-688264; OATM-5) Avail: CFSTI CSCL 15/5

With the introduction of the C-5A in the 1970 time frame, it is envisioned that air transportation will be competitive with surface transportation for a great many more items than previously. The paper discusses a new cost formula which measures both inventory costs and transportation costs, and which can be applied to existing items in the inventory and to new items as they come into the inventory, to ascertain if they are air eligible both under todays rates and under the C-5A rates. Author (TAB)

N69-36467*# Litchford Systems, Northport, N.Y.

SUGGESTED TEST OF A SELF-CALIBRATING BARO-HEIGHT REPORTING CONCEPT FOR GENERAL AVIATION AND AIRLINE SSR Interim Scientific Report

Aug. 1969 25 p

(Contract NAS12-2071)

(NASA-CR-86216) Avail: CFSTI CSCL 01C

The design concepts for a self-calibrating barographic altimeter are presented with the restrictions, problems, errors and costs. A general description of the system is given. One of the requirements is that the aircraft must fly over the normal marker beacon within 11° of the zenith of the vertical marker to avoid significant error. The use of ground radar with photocell monitors to determine the altitude is proposed. This would also disclose the presence of other aircraft within the marker. Radiation patterns and the crossed beam concept are discussed, and schematics of the concepts are included. F.O.S.

N69-36474# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT USE OF THE KINETIC ENERGY OF THE STREAM OF A TURBOJET ENGINE FOR CREATION OF ADDITIONAL LIFT ON THE WING OF AN AIRCRAFT

V. A. Kosterin et al 6 Mar. 1969 20 p refs Transl. into ENGLISH from Tr. Kazansk. Aviats. Inst. (Kazan), no. 88, 1965 p 92–103

(AD-688782; FTD-MT-24-430-68) Avail: CFSTI CSCL 1/3

The results are given of the experimental investigations of the pressure distribution over the surfaces of a plane-plate wing and a wing with a 12.5 percent relative thickness, both located inside a flow at various angles of attack and temperature, and at various flow speeds. In the investigations carried out under static conditions, during which a plane gas jet was fed tangentially to the upper wing surface at the point of the maximum airfoil thickness, even assuming a jet-aircraft lift-drag ratio of 10, it was found to be feasible to obtain supplementary lift (up to 21 percent of momentum) by deflecting the outlet momentum vector by up to 12 degrees. The deflection can be effected by deflecting jet engine nozzles or by utilizing the Coanda effect. It is concluded that the flying-engine configuration, i. e., the engine-wing combination in which exhaust gases are conveyed in wing slots, is feasible and that the design should be investigated in drifting flow. Author (TAB)

N69-36503*# California Univ., Davis. Coll. of Engineering.

CONTROL POWER REQUIREMENTS OF IUTOL AIRCRAFT Quarterly Status Report, 1 Apr. – 30 Jun. 1969

Myron A. Hoffman 30 Jun. 1969 13 p refs

(Grant NGR-05-004-051)

(NASA-CR-105632; QSR-1) Avail: CFSTI CSCL 01C

A computer program was used to obtain a representative intercity tilt-wing VTOL design for the purpose of evaluating control power requirements. Basic program inputs are design cruise speed, altitude, range, and number of passengers. The outputs include a

detailed weight breakdown, key vehicle dimensions, and requirements for fuel and time in each phase of the mission. Direct operating costs were also obtained by computer program. The reference design grosses about 54,000 lbs and carries 80 passengers over a stage length of 200 miles at cruise speeds of 400 mph at 20,000 ft cruise altitude. Power is provided by four turboprop engines. The computer printouts reflecting direct operating costs, design data, performance, and control power requirements are presented. K.W.

N69-36540# Royal Aircraft Establishment, Farnborough (England).
THE INFLUENCE OF LIFTING-SURFACE INTERFERENCE ON THE LONGITUDINAL MOTION OF A FLEXIBLE FLIGHT-VEHICLE [BEITRAEGE ZUM EINFLUSS DER TRAGFLAECHEN-INTERFERENZ AUF DIE LAENGSBEWEGUNG EINES FLEXIBLEN FLUGKOERPERS]
Peter Hamel Apr. 1969 88 p refs Transl. into ENGLISH from GERMAN Thesis
(RAE-LIB-TRANS-1361) Avail: CFSTI

An analytical procedure for determining unsteady aerodynamic time-delay effects on the longitudinal stability of flexible flight-vehicles with tandem lifting surfaces is presented. The dynamic behavior of the aeroelastic-coupled system is described by differential–difference equations which are Laplace-transformable. The stability roots can be extracted from the corresponding transcendental characteristic equation by simple and suitable series approximations. The root-locus technique is applied to demonstrate how strongly the aerodynamic time-delay destabilizes the first bending mode of the fuselage for certain tandem configurations. The time-vector concept is being used for physical interpretation. In addition, the classical root-locus method is extended to find exact critical values for time-delays and to determine the behaviour of the root-locus curve in the neighborhood of a critical point. Some results of parametric and sensitivity investigations are given to show how aeroelastic coupling and aerodynamic interference influence the stability of rigid body (short-period) and elastic body (body-bending) modes. Author

N69-36683*# Mitre Corp., Bedford, Mass.
A PRELIMINARY STUDY OF A SATELLITE AIDED VEHICLE AVOIDANCE SYSTEM (SAVAS) Final Report
G. Glatfelter, W. Goldberg, and M. Gould 3 Apr. 1969 100 p refs
(Contract NAS12-2078)
(NASA-CR-86230) Avail: CFSTI CSCL 01C

The principle of the SAVAS system is the use of a signal from a satellite to synchronize a responding signal from each aircraft. After receipt of the satellite signal, each aircraft initiates with minimum delay a clock, a receiving gate, and a responding signal. The responding signal is received by all other aircraft within range and measured for time delay with respect to starting times of the clock, the receiving gate, and rate of change of time delay. The system theory is described in detail, with emphasis on operational application. Equipment aspects and possible techniques for implementation are considered. Preliminary design alternatives and component data are identified to indicate the complexity of the system. K.W.

N69-36694# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
SINUSOIDAL VIBRATION TESTS ON DEVELOPMENT MODEL OF EXPERIMENT S-126 FOR TD-2 SPACECRAFT
P. C. van der Waal 4 Sep. 1968 24 p
(RV-23) Avail: CFSTI

Sinusoidal vibration tests were executed on the S-126 experiment. Vibration responses were measured and are reported. Severe and unacceptable resonances occurred in the vicinity of the photomultipliers. During development tests this problem was partially solved but could not be finished because of the stopping of TD_2 activities. There were no other serious problems. Author

N69-36702# Atlantic Research Corp., Costa Mesa, Calif. Missile Systems Div.
AN ESTIMATE OF POSITIONAL, ANGULAR, AND VELOCITY UNCERTAINTIES AS DETERMINED FROM TRIPLE THEODOLITE WIND SOUNDINGS Final Report, 15 Feb. 1968–15 Mar. 1968
Robert L. Ammons 15 Mar. 1969 143 p refs
(Contract F19628-68-C-6270)
(AD-688916; AFCRL-69-0129) Avail: CFSTI CSCL 4/1

The data from 6,358 triple theodolite measurements of pilot balloon position have been reduced, and an estimate of the positional and angular uncertainties determined. The technique employed consists of a least-squares positional solution of the balloon position, which is shown to result in a different balloon position (and angular variance) than a least-squares-angular solution. The relative merits of the two solutions are discussed, as are advanced techniques of estimating balloon velocity. The balloon positional uncertainties and theodolite angular uncertainties (defined by the least-squares positional solution) are shown to have other than a Gaussian distribution, and their dependence upon balloon altitude and velocity is discussed. Author (TAB)

N69-36731# Bell Aerosystems Co., Buffalo, N.Y.
OPERATIONAL HISTORY AND EXPERIENCE WITH THE BELL SK-5 AIR CUSHIONED VEHICLE (ACV)
J. A. Cannon *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 33 (See N69-36726 21-15)
Avail: CFSTI

The active participation of the air cushion vehicle in the Vietnam war has produced an opportunity to evaluate a limited number of ACV's (6 total craft) under the most rigorous and extreme environmental and combat conditions. Introduction of a new and unique vehicle which was originally designed for commercial applications into a military environment has necessitated the development of unique measures for assessing the reliability and maintainability of these crafts. This paper presents some of the results of this assessment in terms of operational readiness and other system effectiveness indices. Author

N69-36734# Pan American World Airways, Inc., New York.
AN INTEGRATED COMPUTERIZED RELIABILITY MONITORING PROGRAM FOR AIRCRAFT SYSTEMS AND COMPONENTS
N. Ron, A. L. Reznick, and L. Das *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 67–77 ref (See N69-36726 21-15)
Avail: CFSTI

Proposed is a computer program that will attempt to correct deficiency problems in aircraft systems and components as they arise by automatically supplying the processed data necessary for decision making and corrective action. The program attempts to optimize such parameters as cost, utility, and response within the reliability function of aircraft maintenance systems by means of statistical tools, flag out systems and components that show any undesirable trend in their performance. G.G.

N69-36737# Air Canada, Montreal (Quebec).
QUALITY CONTROL IN A LARGE AIRLINE

Russ J. Thatcher *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 127–150 (See N69-36726 21-15)
Avail: CFSTI

Reliability engineering and quality control procedures for a large commercial airline operation encompass power plants and shops, ground equipment and facilities, and the aircrafts themselves. A total overall ratio of one quality inspector for every twenty mechanics assures high operational standards. Routine maintenance check work will only be performed for detection and correction of deteriorating or substandard conditions. The authors believe that the majority of failures cannot be predicted but have to be dealt with as they arise. G.G.

N69-36769 Royal Netherlands Aircraft Factories Fokker, Amsterdam.
RESPONSE OF AIRCRAFT TO ELEVATOR OR RUDDER APPLICATION AND ENGINE FAILURE
W. J. van Hooff 1 Sep. 1967 36 p refs
(G.o-11) Avail: CFSTI

Load cases related to sudden control applications and conditions in which an external force acting on the aircraft is built up or changed suddenly are analyzed. The basic equations of motion are provided for analyzing pitch, yaw, and non-dimensional time. The equations are solved for aircraft responses to triangular and sinusoidal time-dependent perturbations. In addition, loading parameters are presented for tailplane load and aircraft load factor, angular acceleration, and angular velocity. Application of the results is briefly discussed. K.W.

N69-36770 Royal Netherlands Aircraft Factories Fokker, Amsterdam.
AIRCRAFT LOAD CASES: LOCAL ACCELERATIONS (BASIC CALCULATION METHOD)
H. N. M. v. Bakkum 16 Oct. 1967 10 p
(G.o-16) Avail: CFSTI

General formulas and simplifications are presented for obtaining acceleration loads on front and rear of the fuselage, port and starboard wings, total for wings, and total for fuselage. The accelerations are derived from translational and rotational components along all three axes. The translational component yields the aircraft load factors, and the rotational component yields the angular and centripetal accelerations. K.W.

N69-36783# Massachusetts Inst. of Tech., Cambridge. School of Engineering.
SUPERSONIC AND HYPERSONIC FLIGHT
Raymond L. Bisplinghoff *In* School of Aerospace Med. Biosstronaut. and the Exploration of Space Nov. 1968 p 95–111 refs (See N69-36776 21-04)
Avail: CFSTI

The feasibility, operating principles, and structural mechanics of commercial supersonic and hypersonic aircraft are discussed. the design of such aircraft makes use of principles developed by the French engineer Louis Breguet, who showed that the range of an airplane, or the maximum distance it can travel, depends upon two factors: (1) flight efficiency; and (2) the ratio of fuel weight to gross weight at the beginning of flight. Equations are presented, and the above factors are analyzed in relation to supersonic and hypersonic flight. Structural design problems involving aeroelasticity and aerodynamic heating, as well as sonic boom are also briefly treated. It is concluded that at the present time such commercial air transportation is potentially feasible and economically attractive, but that technological improvements are required in order to refine design requirements and improve aerodynamic, structural and propulsion efficiency. A.C.R.

N69-36807*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
ANALYSIS OF THE FLAT-SPIN CHARACTERISTICS OF A TWIN-JET SWEPT-WING FIGHTER AIRPLANE
Joseph R. Chambers, James S. Bowman, Jr., and Emie L. Anglin Washington Sep. 1969 35 p refs
(NASA-TN-D-5409) Avail: CFSTI CSCL 01C

An investigation was conducted to determine the significant factors affecting the flat-spin characteristics of a contemporary high-performance fighter airplane having horizontal tail surfaces with negative geometric dihedral (droop). Various phases of the study included static and forced-oscillation wind-tunnel tests, rotary-balance tests, single-degree-of-freedom autorotation tests, and free-spinning tests of a dynamically scaled model. Author

N69-36988# Library of Congress, Washington, D.C. Aerospace Technology Div.
SURVEYS OF FOREIGN SCIENTIFIC AND TECHNICAL LITERATURE: SUPERSONIC TRANSPORT AIRCRAFT SUBSYSTEMS
A. Dolgich 12 Jun. 1969 58 p refs
(AD-688829; ATD-69-39-98-1) Avail: CFSTI CSCL 1/3

The first semi-annual report contains fundamental information on Soviet flight control system development, selected mainly from 1968 sources. The materials found are presented in the form of abstracts and analytically selected extracts pertinent to the subject. The scientific sources used for this report contain general design principles which can be used for developing aerospace-craft flight control systems, including those for supersonic transports, missiles, and spacecraft. Author (TAB)

N69-36989# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
SRDS PROGRAM: GOALS, ACHIEVEMENTS, TRENDS Progress Report, 1 Apr. 1968–31 Mar. 1969
31 Mar. 1969 148 p refs
(AD-688827) Avail: CFSTI CSCL 1/2

Material in the report is presented in separate chapters for each of the Systems Research and Development Service technical development divisions, i.e., Air Traffic Control, Communications, Navigation, Environmental, Frequency Management, and Systems Analysis Divisions. Author (TAB)

N69-36998# National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF AIRCRAFT NOISE DURING TAKE-OFF [ETUDE DU BRUIT DES AVIONS AU DECOLLAGE]
Pianko Marc Sep. 1969 47 p refs Transl. into ENGLISH from French Conf. Doc. Presented at the AGARD Propulsion and Energetics Panel Meeting, St. Louis, France
(NASA-TT-F-12441) Avail: CFSTI CSCL 01C

Up to now, aircraft take-off noise reduction studies have concentrated on the prime noise source, the engine. This paper presents a study of noise reduction in a broader context, including specifically the effects of aerodynamic design factors on noise reduction capabilities by maneuvers during take-off. Author

N69-37124# Dynamic Science, Phoenix, Ariz. AvSer Facility.
DEVELOPMENT OF A CRASH-RESISTANT FLAMMABLE FLUIDS SYSTEM FOR THE UH-1A HELICOPTER
S. Harry Robertson Fort Eustis, Va. Army Aviation Materiel Labs. Jan. 1969 184 p refs
(Contract DAAJ02-67-C-0004)
(AD-688165; AvSer-68-6; USAAVLABS-TR-68-82) Avail: CFSTI CSCL 1/3

A crash test of a UH-1A helicopter was conducted to determine the effectiveness of a complete crash-resistant fuel, oil, and electrical system under severe accident conditions. The system included: special crash-resistant fuel and oil tanks, flexible fuel and oil lines that replaced many rigid lines, and self-sealing breakaway valves and fluid-line disconnects at strategic locations. The aircraft was flown by remote control during the crash test, in which all fuel tanks were filled with emulsified JP-4 and the engine was operating on emulsified JP-4. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N69-36048*# Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center.

HEAT STERILIZABLE IMPACT RESISTANT CELL DEVELOPMENT Quarterly Report, 1 Jan. – 31 Mar. 1969

G. F. Nordblom and A. M. Chreitzberg 25 Jul. 1969 63 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951296)

(NASA-CR-105512) Avail: CFSTI CSCL 10C

Volatile components in the epoxy system may be responsible for low capacity as well as cell leakage through crazing during sterilization. A vacuum treatment to remove MEK from the epoxy system is proposed to alleviate crazing and a heating cycle prior to the final seal is beneficial for good capacity. The embrittlement of negative silver grids by mercury is a problem area for high impact cells. Observations indicate that damage which occurs during the first few months may be self-healing on standing about a year. A barrier layer of lead plated on the grid did not solve the problem. The cells should function after about nine months of interplanetary travel. There were available sealed cells which had been on stand or float for about two years. These were discharged and cycled to determine their condition. The data show that cells on float-charge maintained their capacity whereas those on stand lost their capacity and that it could not be regained even after a subsequent recharge. Author

N69-36073*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.

EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: CYCLE LIFE TEST Annual report

D. E. Mains 7 Apr. 1969 380 p

(NASA Order W-12397)

(NASA-CR-105513; QE/C-69-244; AR-5) Avail: CFSTI CSCL 10C

The cycle life test phase of the evaluation program of secondary spacecraft cells is summarized. Nickel–cadmium cells with nonwoven nylon separators, silver–cadmium cells with cellophane separators, and silver–zinc cells with cellophane separators were tested. Environmental conditions include ambient temperatures of –20°C, and one temperature cycle that varies sinusoidally from 0° to 40°C in 48 hours with normal atmospheric conditions. Tables showing cell failure versus cycles completed are included. F.O.S.

N69-36188*# Hughes Aircraft Co., Culver City, Calif. Space Systems Div.

SOLAR CELL RADIATION FLIGHT EXPERIMENT Quarterly Progress Report, 2 Dec. 1968 – 14 Mar. 1969

W. P. Dawson 31 Mar. 1969 41 p refs Prepared for JPL

(Contracts NAS7-100; JPL-952351)

(NASA-CR-105618; SSD-90109R; QPR-2) Avail: CFSTI CSCL 10B

The solar cell radiation flight experiment, scheduled for launch on the ATS-E spacecraft, is to provide high accuracy data permitting a technical evaluation of the effects of the radiation environment in synchronous orbit on selected state-of-the-art solar cell configurations. Data from the flight experiment and supplemental ground test program are a continuation of the work performed by other experimenters and will provide design data required for extended spacecraft missions in synchronous orbit. The flight experiment consists of two small solar panels containing a total of 80 solar cells representing 16 solar cell configurations and two signal processors required to interface with the ATS-E telemetry system. The solar cell radiation flight experiment was initiated on 14 August 1968. The detail design of the flight experiment, project status and results of tests conducted to date are presented. Author

N69-36190*# Exotech, Inc., Washington, D.C. Systems Research Div.

A MODEL FOR SILICON SOLAR CELL PERFORMANCE IN SPACE Final Report

M. J. Barrett and R. H. Stroud 28 Feb. 1969 48 p refs Prepared for JPL

(Contracts NAS7-100; JPL-952246)

(NASA-CR-105639) Avail: CFSTI CSCL 10B

Results of a study of the parameters effecting silicon solar cell performance in space are presented. Comparison of semiconductor theory, radiation effects theory, and reported experimental data has permitted development of a mathematical model for predicting the performance of a solar cell under combinations of radiation exposure, ambient temperature, and illumination spectrum. Limitations on the accuracy and applicability of the model are discussed for future study. Author

N69-36203*# Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.

DEVELOPMENT OF LITHIUM DIFFUSED RADIATION RESISTANT SOLAR CELLS Final Report

P. Payne 20 Mar. 1969 69 p Prepared for JPL

(Contracts NAS7-100; JPL-952247)

(NASA-CR-105606; Rept-11) Avail: CFSTI CSCL 10B

Six hundred lithium doped P/N solar cells were fabricated for radiation testing and analysis. Statistical analysis of the cell outputs was performed for each lot of cells. Ten lots of cells were produced and each lot of 60 cells was fabricated using the same material and diffusion parameters so that large-number statistics could be used in evaluating radiation recovery characteristics. Significant improvements in cell efficiencies were made, particularly with crucible-grown lithium cells. The average output ranged from 26.0 mW for the first lot to 29.0 mW for the tenth lot. Improvements were also made in cell uniformity as shown by the narrow maximum power distributions. In addition, experiments were designed to evaluate and improve processing techniques as well as cell outputs. Lithium evaporations and various lithium diffusion parameters were investigated. Boron diffusions were also studied. By making a process modification the uniformity of lithium cell output was improved. Author

N69-36216*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.

EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: ACCEPTANCE TEST OF MCDONNELL-DOUGLAS, ASTROPOWER DIVISION 5.0 AMPERE-HOUR SILVER-ZINC CELLS

D. E. Maine 15 Aug. 1969 11 p
(NASA Order W-12397)
(NASA-CR-105644; QE/C-69-656) Avail: CFSTI CSCL 10B

Results are presented of acceptance tests made on 5.0 ampere-hour silver-zinc cells. Forty-four cells were tested for seal quality, physical defects, and ampere-hour capacity. Each cell was required to deliver a minimum of 6.5 ampere-hours following the second charge at 350 milliamperes to 2.05 volts. Twenty-five cells failed to deliver 6.5 ampere-hours when discharged at 2.5 amperes to 1.0 volts. Upon completion of the capacity check measurements, visual inspection and phenolphthalein solution revealed electrolyte leakage in all of the cells. D.L.G.

N69-36228*# Texas Instruments, Inc., Attleboro, Mass. Research and Development Lab.
HEAT STERILIZABLE Ni-Cd BATTERY DEVELOPMENT Quarterly Report, 1 Jul. – 30 Sep. 1968
J. P. Elder and R. L. Crawford 30 Sep. 1968 41 p Prepared for JPL
(Contracts NAS7-100; JPL-951972)
(NASA-CR-105641; QR-5) Avail: CFSTI CSCL 10C

The objective of this work is the development of heat-sterilizable, hermetically sealed Ni – Cd cells for space applications. The electrochemical characterization of the sterilized factorial design cells is continuing. Data up to and including cycle #30 are presented. The majority of cells which have failed employ the #14019 polypropylene separator. Selected data from the original 2^4 factorial design were employed to set up a 2^5 factorial design. An analysis of variance of the calculated factor effects has shown that the dominant factor influencing the operation of the Ni – Cd cells is the heat sterilization. However, the concentration and the amount of electrolyte do significantly affect the electrochemical characteristics. The two main characteristics of a heat sterilized cell are (1) an increase of up to 20% in the overall efficiency, above that monitored prior to sterilization, and (2) an increase of the order of 60 mV in the magnitude of the cell terminal voltage at end-of-charge. Author

N69-36261*# Globe-Union, Inc., El Monte, Calif. Centralab Semiconductor Div.
STUDY OF LITHIUM DOPED SOLAR CELLS Quarterly Report
Peter A. Iles 15 Nov. 1968 23 p Prepared for JPL
(Contracts NAS7-100; JPL-952250)
(NASA-CR-105619; Rept-7; QR-2) Avail: CFSTI CSCL 10B

Determination of the properties of silicon solar cells doped with lithium is in progress, and the process parameters which give optimum post-irradiation recovery and good cell stability are reported. For introducing lithium into the cells, oil suspensions were used with final capacity of the diffusion boats increased so that 24 2 cm^2 cells per run could be uniformly diffused. Vacuum evaporation considerably improved the spread in cell characteristics compared to the paint-on method. Distributions of lithium by three types of diffusion cycles are presented graphically and the resulting I – V changes are also plotted. Lithium cells were found to be markedly effected by the growth method used to obtain silicon crystals: crucible grown silicon showed higher saturation current and uniformly higher volt – amperage characteristics throughout the lithium diffusion schedules. M.H.E.

N69-36282*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL MODEL OF A 75 WATT(E) SPACE POWER PLANAR RTG SYSTEM
Andrew J. Parker, Jr. (Hittman Associates, Inc., Columbia, Md.) and William S. West Aug. 1969 43 p Presented at the 4th Ann. Intersoc. Energy Conversion Eng. Conf., Washington, D.C., Sep. 1969 Prepared by Hittman Associates, Inc., Columbia, Md. for NASA
(Contract NAS5-10441)
(NASA-TM-X-63638; X-701-69-327) Avail: CFSTI CSCL 10B

This paper describes the preliminary work accomplished on an advanced thermoelectric design concept for NASA. This concept has possible application to deep space missions and may offer additional flexibility in the integration of a power supply with spacecraft. The concept differs from conventional omnidirectional thermal radiator devices in that it uses a planar, unidirectional or bidirectional, radiator. The accomplishments include design, fabrication, and test of a full size thermal model to establish feasibility of the concept. Author

N69-36270*# Cara Corp., Philadelphia, Pa.
THE RELATION BETWEEN SOLAR CELL FLIGHT PERFORMANCE DATA AND MATERIALS AND MANUFACTURING DATA Quarterly Report
S. R. Pollack [1969] 37 p refs
(Contract NASw-1732)
(NASA-CR-105614; QR-3; Rept-3) Avail: CFSTI CSCL 10B

Analysis of the environment for the individual flights was begun while trying to simplify the environmental specification. The most difficult aspect of the environmental analysis is the specification of the vehicle's thermal history. The vehicles under study are being grouped according to subclassifications based on the nature of the vehicle as the first attempt to find any performance correlations. All of the specific data for the flights under study was extracted from the literature obtained from the computer searches. These data are incomplete and inadequate for this study. Author

N69-36277*# Catholic Univ. of America, Washington, D.C. Dept. of Physics.
THEORETICAL INVESTIGATION OF RADIATION DAMAGE AND TRANSPORT PROPERTIES OF SOLAR CELLS Final Status Report, Jan. 1968 – Aug. 1969
Tomoyasu Tanaka Aug. 1969 7 p refs
(Grant NGR-09-005-014)
(NASA-CR-105598) Avail: CFSTI CSCL 10B

Radiation damage in solar cells is investigated from a phenomenological, and a quantum mechanics treatment standpoint. Interference effect on annealing temperature of A-centers and E-centers in silicon are interpreted. The mechanism of creation and annihilation of defects and centers created in semiconductors by irradiation is treated by simplified mathematical models. The first principal calculation of the energy of formation of a defect in metals and semiconductors is discussed. F.O.S.

N69-36290*# Atomics International, Canoga Park, Calif.
ALUMINUM BONDED LEAD TELLURIDE THERMOELECTRIC MODULE STUDY FOR NON-MAGNETIC AND VACUUM APPLICATIONS Summary Report, 5 Mar.-6 Nov. 1968
7 Feb. 1969 55 p
(Contract NAS5-11514)
(NASA-CR-105650; AI-69-16) Avail: CFSTI CSCL 10A

Research and development results on the power density, efficiency, and the stability of aluminum-coated PbTe thermoelectric test modules made wholly of nonmagnetic materials and operated in vacuum are reported. Principal tasks have been to continue the life tests already in operation, to replace damaged or seriously degraded test modules, to build and operate a large-module efficiency demonstration, to perform a mechanical (vibration) test on one small module, and to evaluate all information obtained, including the

results of destructive analyses. Evaluation of all test results indicates that PbTe thermoelectric converters using the bonded aluminum contact technology can be engineered to meet the following specifications: (1) neutrally magnetic materials throughout, (2) operable in high vacuum without containment, (3) capable of withstanding launch conditions, (4) moderately high specific power (about 6 watts/lb of converter), (5) moderately high overall conversion efficiency (5 to 6%), and (6) good stability. Author

N69-36308*# Electric Storage Battery Co., Yardley, Pa. Research Center.
ALKALINE BATTERY SEPARATOR CHARACTERIZATION STUDIES Quarterly Report, 23 Jun. – 23 Sep. 1968
J. J. Kelley 23 Sep. 1968 21 p
(Contract NAS5-10418)
(NASA-CR-105623; QR-5) Avail: CFSTI CSCL 10C

The results of additional separator and characterization tests on Permion 2291 membranes and non-woven absorbers, Pellon 2530, and Kendall EM 476, are reported. Permion 2291 gave satisfactory performance in the cell cycling testing of Ag-CdO and Ni-Zinc cells and is to be further tested. Cell testing of the polybenzimidazole, and pyrrone films and the inorganic separators was completed but with inconclusive results. In all but the case of the pyrrone film, cracking of the separator appears to have contributed to the failure. With the pyrrone film, silver penetration in very localized areas was the cause of failure. Electrolyte absorbant separators, such as Pellon, were investigated to determine physical properties and wetting characteristics. Author

N69-36351*# Catalyst Research Corp., Baltimore, Md.
DEVELOPMENT OF A LONG LIFE THERMAL CELL Final Report
H. J. Goldsmith and J. R. Moser 15 Aug. 1967 196 p refs
(Contract NAS3-8517)
(NASA-CR-72361) Avail: CFSTI CSCL 10B

Research was directed toward the development of a thermal battery using a magnesium anode, copper oxide cathode, a separator and eutectic fused salt, 59 mole percent lithium chloride plus 41 mole percent potassium chloride, operating at 800°F. The initial work concentrated on the choice of five proposed separators, five cathode configurations, and five CuO/Cu_2O cathode compositions. Full cells using 100% CuO and 100% Cu_2O needle type cathodes operated satisfactorily at the two and six day discharge rates. Cathodes made of 100% CuO showed efficiencies between 67.1% and 89.0% at the two day discharge rate while the efficiencies at the six day discharge rate were between 75.0% and 78.2%. For 100% Cu_2O cathodes at the two and six day discharge rates were between 78.5% and 88.8% and then 71.4% and 82.7%, respectively. Based on the greater energy density and ease of fabrication, the use of pure cupric oxide cathodes was recommended. A design for a 50 ampere hour cell based on results of 14 ampere hour tests is presented in detail and recommendations are included for component improvements. A method is described to control excessive cathode expansion during discharge along with details allowing the cell to be operated omnipositionally and under zero gravity conditions. Author

N69-36411*# General Electric Co., Schenectady, N.Y. Tube Dept.
REDUCTION OF RECOVERY TIME IN HIGH-TEMPERATURE CESIUM VAPOR THYRATRONS
A. W. Coolidge, Jr. Washington NASA Sep. 1969 47 p refs
(Contract NAS3-9423)
(NASA-CR-1417) Avail: CFSTI CSCL 10B

An existing cesium vapor thyratron design was modified with the goal of reducing the recovery time from 300 to 100 microseconds. The approach taken was to facilitate ion-electron recombination by reducing the path lengths traversed by the ions after the cessation of current conduction. This included reduction of grid-to-anode spacing, grid-to-cathode spacing, and a reduction in the width of the grid slots. Although the tubes fabricated with these modifications were more difficult to fire and exhibited slightly increased voltage drop, stable operation was achieved for extended time periods in an inverter circuit. Author

N69-36661*# Naval Ammunition Depot, Crane, Ind.
[SPACE CELL TEST PROGRAM] Progress Report
31 Aug. 1969 57 p
(NASA Order S-23404-G)
(NASA-CR-105721) Avail: CFSTI CSCL 10B

Tests were performed on space cells to determine performance with various separator materials, storage of cells on open circuit or continuous charge conditions, under environmental conditions simulating those encountered by the Explorer 35 space vehicle, and under conditions similar to those abroad a Synchronous Orbit Satellite. Test procedures are described, and results included. F.O.S.

N69-36689*# Naval Ammunition Depot, Crane, Ind.
[SPACECRAFT CELL TESTING PROGRAM] Monthly Progress Report
31 Aug. 1969 33 p
(NASA Order W-12-397)
(NASA-CR-105719) Avail: CFSTI CSCL 10B

Silver-cadmium, silver-zinc, nickel-cadmium, lead-calcium, and lead-acid cells with a rated capacity range from 1.25 to 50 ampere-hours were tested. Cells being tested and cells having completed the tests are listed and identified. The test parameters for each cell are given in printout tables. The data include ampere-hour capacity, charge-discharge cycle time, depth of discharge, cycling temperature, type of charge control, charge/discharge currents, voltage limits, and failures. K.W.

N69-36758*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF SIMULATED SPACE ENVIRONMENT ON FULL, HALF, AND QUARTER-SIZE CADMIUM SULFIDE THIN-FILM SOLAR CELLS
Anthony F. Ratajczak, Thomas M. Klucher, and Clifford K. Swartz Washington 16 p refs
(NASA-TM-X-1884) Avail: CFSTI CSCL 10B

Full-, half-, and quarter-size CdS thin film solar cells were subjected to a simulated space environment to test the effect of cell size on performance degradation. The test data indicate that there is more variation in degradation among common size cells than between different size cells and that cell degradation does not appear to be substantially affected by cell size. Author

N69-36829*# Whittaker Corp., San Diego, Calif.
ELECTROCHEMICAL CHARACTERIZATION OF NONAQUEOUS SYSTEMS FOR SECONDARY BATTERY APPLICATION
Manny Shaw, O. A. Paez, and Frank A. Ludwig Washington NASA Sep. 1969 229 p refs
(Contract NAS3-8509)
(NASA-CR-1434) Avail: CFSTI CSCL 10B

Approximately one thousand electrode-organic electrolyte combinations have been characterized relative to their use as rechargeable battery systems, using the method of cyclic

voltammetry. Electrode systems consisted of silver, copper, nickel, cobalt, zinc, cadmium, indium, iron, molybdenum, chromium, manganese, vanadium, lithium, calcium, and magnesium. In general, the most promising positive metals were silver, copper, zinc, cadmium, and indium. A large majority of the nickel, cobalt, and iron systems exhibited no discharge peaks at all, and in most cases negligible discharge current. Twenty-four recommended systems comprising silver, copper, zinc, and cadmium, were further characterized by constant-current charge and discharge of sintered electrodes. Author

N69-36843*# General Electric Co., Schenectady, N.Y. Tube Dept.
DEVELOPMENT AND INVERTER TESTING OF HIGH TEMPERATURE CESIUM-VAPOR THYRATRONS
A. W. Coolidge, Jr. Washington NASA Sep. 1969 47 p refs
(Contract NAS3-9423)
(NASA-CR-1435) Avail: CFSTI CSCL 09E

Cesium vapor thyratrons were developed for operation at 200° C to 300° C, in a vacuum environment. The tubes were rated 15 amperes average current, 250 volts peak forward and inverse. A major effort consisted of reducing the recovery time from over 300 microseconds to less than 100 microseconds. The tubes were endurance tested over 3000 hours in an inverter circuit. Author

N69-36919# Army Electronics Command, Fort Monmouth, N.J.
RARE-EARTH OXIDE RADIATORS FOR THERMO-PHOTOVOLTAIC ENERGY CONVERSION
Guido F. A. Guazzoni Apr. 1969 24 p refs
(AD-688068; ECOM-3116) Avail: CFSTI CSCL 10/2

An experimental analysis is presented with the objective of finding selectively radiating materials with high spectral emissivity in a narrow wavelength band centered about the region of maximum response of the germanium and silicon thermophotovoltaic cells and low emissivity elsewhere in the spectrum. A group of rare-earth oxides (Er_2O_3, Sm_2O_3, Nd_2O_3, Dy_2O_3, and Yb_2O_3) has been studied. Their emission spectra have been obtained and evaluated in terms of total radiation measurements and short-circuit current output of germanium and silicon cells. In terms of the evaluated performance parameters, all the rare-earth oxides which were examined showed a significant spectral improvement compared with silicon carbide (gray body) and black-body reference sources. Er_2O_3 and Yb_2O_3 give the most promise as improved radiators for application in thermophotovoltaic energy conversion. Author (TAB)

N69-36938*# McDonnell-Douglas Astronautics Co., Newport Beach, Calif. Astropower Lab.
DEVELOPMENT AND TESTING OF A FIVE-Ah SILVER CADMIUM CELL Final Report, 7 Jul. 1969 – 6 Apr. 1969
A. Himy Aug. 1969 168 p ref
(Contract NAS3-10925)
(NASA-CR-72587; DAC-60525-F) Avail: CFSTI CSCL 10B

A 5 Ah silver-cadmium cell using purchased cadmium electrodes and an inorganic separator was designed. All other components and techniques used were identical to those used on a concurrent program related to a 5 Ah silver-zinc cell. The selected design was evaluated on a 40% depth-of-discharge, 1.5-hour cycling period, regime at 25°C. Several groups of five cells with minor variations were tested. The 40% KOH concentration appeared to establish a capability of at least 4700 such cycles. The cells were tested using 30% and 40% KOH on various cycling regimes conducted at 25°C and 100°C. Pressure and gas analysis data were obtained on some cells. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology

N69-36025 Missouri Univ., Columbia.
AN X-RAY STUDY OF INTERPARTICLE INTERACTIONS
Ted Ray Taylor (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-3418

Small angle X-ray scattering data from concentrated suspensions of southern bean mosiac virus and Na-montmorillonite clay were analyzed to calculate their pair correlation functions and pair potentials. The virus is composed of nearly uniform spherical particles, and the clay particles are platelets with a diameter much larger than their thickness. The pair correlation function and potential energy of southern bean mosiac virus were computed for concentrations of 20, 10 and 5 gm of virus per 100 ml of suspension. The pair correlation functions indicated relatively weak interparticle forces. The pair potential was found to be repulsive for all concentrations. One-dimensional pair potentials were calculated for six samples of Na-montmorillonite clay suspensions containing 10% clay by weight and various sodium metaphosphate concentrations. Potentials were also calculated for a set of five samples with varying clay and sodium metaphosphate concentrations. The pair potentials showed that the addition of sodium metaphosphate to 0.005 N had very little effect on the potential between pairs of platelets. Variation of the form of the potential with metaphosphate concentration suggests that there may be forces other than repulsive double layer and attractive Van der Waals forces acting between pairs of platelets. Dissert. Abst.

N69-36068# Joint Publications Research Service, Washington, D.C.
SOVIET CYBERNETICS
11 Jul. 1969 68 p refs Transl. into ENGLISH from Probl. Kibernetiki (Moscow), no. 20, 1968 p 131–143, 217–223, 241–255, 257–276
Avail: CFSTI

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1. BEHAVIOR OF A GROUP OF AUTOMATA IN THE PROBLEM OF POWER REGULATION V. L. Stefanyuk p 1–15 refs (See N69-36067 21-07)
2. ALGEBRAIC OPERATIONS ON SYSTEMS OF OBJECTS A. M. Slinko p 16–23 (See N69-36068 21-19)
3. AUTOMATION MODEL OF THE HEART A. T. Kolotov p 24–42 refs (See N69-36069 21-04)
4. ON MODELING THE EVOLUTIONARY PROCESS CONSIDERING SELECTION T. I. Budgekova et al p 43–49 ref (See N69-36070 21-04)
5. CONCERNING MODELS OF THE COMPETITION OF SPECIES T. I. Bulgakova p 50–58 refs (See N69-36071 21-04)
6. CONCERNING THE STABILITY OF THE SIMPLEST MODEL OF BIOGEOCENOSIS T. I. Bulgakova p 59–65 ref (See N69-36072 21-04)

N69-36069# Joint Publications Research Service, Washington, D.C.
AUTOMATON MODEL OF THE HEART
A. T. Kolotov *In its* Soviet Cybernetics 11 Jul. 1969 p 24–42 refs (See N69-36066 21-04)
Avail: CFSTI

A discrete net of automata is described which may also serve as a model of the heart that incorporates a number of clinically observed properties of this organ. Particular attention is given to processes involving the onset and cessation of palpitation. In many respects, a comparison of this model with actuality can be carried further than in the case of a continuous model. A.C.R.

N69-36070# Joint Publications Research Service, Washington, D.C.
ON MODELING THE EVOLUTIONARY PROCESS CONSIDERING SELECTION
T. I. Budgekova et al *In its* Soviet Cybernetics 11 Jul. 1969 p 43–49 ref (See N69-36066 21-04)
Avail: CFSTI

A theory identifying the initial states of model populations, a treatment considered particularly favorable for studies of the evolutionary process, is analyzed for the condition when selection is introduced into the model. This condition leads to the occurrence of considerable drift in the population genotypes, and the basic mass evolves in a direction dictated by selection. Due to purely statistical circumstances, however, small groups of individuals split from the population; these are comparatively homogeneous in genotype and isolated in the sense of the possibility of having descendants. As such, they represent dead ends of evolution, or at best they evolve much more slowly. The basic mass of the population is therefore strongly mixed in genotype under the influence of selection, while relic forms exist which are distinct from the mass in genotype, few in number, and much less mixed. One problem involved clarifying whether or not the analogous phenomenon is observed in a comparatively rapidly evolving natural population, a factor which must be considered in constructing a mathematical theory of evolution. A.C.R.

N69-36071# Joint Publications Research Service, Washington, D.C.
CONCERNING MODELS OF THE COMPETITION OF SPECIES
T. I. Bulgekova *In its* Soviet Cybernetics 11 Jul. 1969 p 50–58 refs (See N69-36066 21-04)
Avail: CFSTI

Several theories regarding competition of biological species for food are briefly summarized and a model of competition proposed by A. A. Lyapunov is considered. This model consists of two species, y_1 and y_2, competing for food. The amount of food or the number of a third species, i.e., the victim, is x. In the absence of consumers, the amount of food is found to increase exponentially according to a set system of equations. The coordinates of the stationary point are calculated, as well as the necessary and sufficient conditions for the existence of a stable stationary point. From this, it is determined that the existence of intraspecies competition is a necessary condition for the system's stability. Attempts were also made to study the effect of hunting on a system with competing species. Finally, a model of competition for a particular case is considered, and formulas are derived for conditions under which a system with two species can exist for an infinitely long period of time. A.C.R.

N69-36072# Joint Publications Research Service, Washington, D.C.
CONCERNING THE STABILITY OF THE SIMPLEST MODEL OF BIOGEOCENOSIS
T. I. Bulgakova *In its* Soviet Cybernetics 11 Jul. 1969 p 59–65 ref (See N69-36066 21-04)
Avail: CFSTI

Models of trophic bonds in biogeocenosis are constructed in an investigation of stationary point stability for the simplest model. The general system to be modeled is described as one which includes populations of living organisms located in the same territory with different types of food at the disposal of each species. Each food consists of a number of components, and the composition is constant. An expression can therefore be formulated for the amount of food, and the dynamics of the number of species can be described by a system of differential equations. The simplest model is one in which one species is fed by one type of food with a single-substance component; this is analyzed to obtain the stationary point stability. A.C.R.

N69-36091# Joint Publications Research Service, Washington, D.C.
SELECTIONS FROM THE SOVIET JOURNAL SCIENCE AND RELIGION
24 Jul. 1969 15 p Transl. into ENGLISH from Nauka i Religiya (Moscow), no. 5, 1969 p 22–30
(JPRS-48484) Avail: CFSTI

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1. LONG RANGE SCIENTIFIC PREDICTIONS ANALYZED V. I. Siforov p 1–6 (See N69-36092 21-04)
2. SIMULATION OF PSYCHOLOGICAL FUNCTIONS STUDIED A. Dobrovich p 7–14 (See N69-36093 21-04)

N69-36092# Joint Publications Research Service, Washington, D.C.
LONG RANGE SCIENTIFIC PREDICTIONS ANALYZED
V. I. Siforov *In its* Selections from the Soviet J. Sci. and Religion 24 Jul. 1969 p 1–6 (See N69-36091 20-04)
Avail: CFSTI

A discussion and an analysis of long range scientific predictions, especially in computer science, are offered. Does one need concern himself with long range forecasting, is it possible to foresee the distant future, what path leads to this, and what will be the social consequences of exceptionally rapid development of science and engineering, are some of the topics considered for discussion. J.M.C.

N69-36093# Joint Publications Research Service, Washington, D.C.
SIMULATION OF PSYCHOLOGICAL FUNCTIONS STUDIED
A. Dobrovich *In its* Selections from the Soviet J. Sci. and Religion 24 Jul. 1969 p 7–14 (See N69-36091 20-04)
Avail: CFSTI

A computerized simulation of psychological functions is offered as a means for man to become more familiar with himself. A comparison of the automatic machine with the human brain showed the computer as a never tiring, nonconfused, or distracted entity. Descriptive names are given to gifted and defective computers. J.M.C.

N69-36117# Haskins Labs., Inc., New York.
SPEECH RESEARCH Progress Report, 1 Oct.–31 Dec. 1968
Franklin S. Cooper Jun. 1968 152 p refs
(Contract N00014-67-A-0129)
(AD-676520; SR-12) Avail: CFSTI CSCL 17/2

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3. EXPERIMENTAL METHODS FOR SPEECH SYNTHESIS BY RULE I. G. Mattingly p 103–115 refs (See N69-36120 21-04)

4. A SIMPLE PROGRAM FOR SYNTHESIZING BRITISH ENGLISH M. P. Haggard and I. G. Mattingly p 117–129 refs (See N69-36121 21-04)

5. RULES FOR WORD STRESS ANALYSIS FOR CONVERSION OF PRINT TO SYNTHETIC SPEECH J. H. Gaitenby p 131–141 refs (See N69-36122 21-04)

6. DISCRIMINATION OF THREE-FORMANT NASAL-VOWEL SYLLABLES, PART 3 E. Garcia p 143–153 refs (See N69-36123 21-04)

N69-36118# Haskins Labs., Inc., New York.
ON THE MOTOR CONTROL OF COARTICULATION IN CVC MONOSYLLABLES
Peter F. MacNeilage and Joseph L. DeClerk (ECOM) *In its* Speech Res. Jun. 1968 p 9–78 refs Presented at the Conf. on Speech Commun. and Process., Cambridge, Mass., 6–8 Nov. 1967 (See N69-36117 21-04)
Avail: CFSTI

This study was an attempt to account for the motor control of speech production by a model in which discrete phoneme commands are modified according to phonological context by 3-motor system mechanisms. The model was evaluated by consideration of high-speed cinefluorograms, and electromyograms from 9 articulatory locations, recorded while one subject produced 36 consonant–vowel–consonant monosyllables. In every possible case some aspect of the motor control of a later syllable component was influenced by the identity of the previous one. Except in a few cases, some aspect of the motor control of an earlier syllable component was influenced by the identity of the following one. Some of the context effects on phonemes could be accounted for by the 3-motor system mechanisms, but a number could not. The results suggested that syllabic factors are influential in the premotor command structure of speech, and that the CV form is a relatively cohesive component of CVC syllables. Author

N69-36119# Haskins Labs., Inc., New York.
STUDY OF NON-SPEECH VOLUNTARY PALATE MOVEMENTS BY SCALING AND ELECTROMYOGRAPHIC TECHNIQUES
Ralph L. Shelton, Katherine S. Harris, George N. Sholes, and Patricia M. Dooley *In its* Speech Res. Jun. 1968 p 79–101 refs (See N69-36117 21-04)
Avail: CFSTI

This report concerns the voluntary, non-speech movements produced on command without the benefit of visual feedback or of the auditory feedback that would be associated with phonation. The study includes the subjects awareness of movement but not if he succeded in his attempt to complete the task. Results suggest that subjects learn to make voluntary palate elevations and these elevations agree fairly well with electromyographic measures. Results also suggest that these movements decrease under fatigue. E.H.W.

N69-36120# Haskins Labs., Inc., New York.
EXPERIMENTAL METHODS FOR SPEECH SYNTHESIS BY RULE
Ignatius G. Mattingly *In its* Speech Res. Jun. 1968 p 103–115 refs Presented at the Conf. on Speech Commun. and Process., Cambridge, Mass., 6–8 Nov. 1967 Submitted for publ. (See N69-36117 21-04)
Avail: CFSTI

An experimental system for speech synthesis by rule was developed which consists of a resonance synthesizer, a DDP-224 digital computer, associated peripheral devices, and two computer programs. The objectives of the design were flexibility, suitability for computer control, and reliability. For the flexibility the resonant circuits are in parallel. Reliability was achieved with the recent advances in electronics. Author

N69-36121# Haskins Labs., Inc., New York.
A SIMPLE PROGRAM FOR SYNTHESIZING BRITISH ENGLISH
Mark P. Haggard and Ignatius G. Mattingly *In its* Speech Res. Jun. 1968 p 117–129 refs Presented at the Conf. on Speech Commun. and Process., Cambridge, Mass., 6–8 Nov. 1967 Submitted for publ. (See N69-36117 21-04)
Avail: CFSTI

A procedure for synthesizing British English was developed which incorporates certain economies at little apparent cost in intelligibility, and introduces some rules for allophones which improve quality. Tests are reported with intelligibility around 90 percent, and improvements suggested for the major sources of errors. The assumptions in the procedure for synthesizing speech by rule both summarize and suggest research on fundamental aspects of speech, and thus constitute a model for some aspects of speech production and speech perception. Author

N69-36122# Haskins Labs., Inc., New York.
RULES FOR WORD STRESS ANALYSIS FOR CONVERSION OF PRINT TO SYNTHETIC SPEECH
Jane H. Gaitenby *In its* Speech Res. Jun. 1968 p 131–141 refs Presented at the 74th Meeting of the Acoust. Oc. of Am., Miami Beach, Fla., 15 Nov. 1967 Submitted for publ. (See N69-36117 21-04)
Avail: CFSTI

An attempt to program a machine to amke its own phonetic judgments of the textual input without the aid of humans is proposed. To accomplish this, a clear cut set of rules for the conversion of printed letters to speech-like phones was undertaken. A test of nonsense words for humans to read was set up to determine how they stress unknown words. Results indicate that different amounts of stress are placed on different types of words, and that vowels play an important part in how much stress a word receives. From these observations a set of rules is being formulated for the conversion process. E.H.W.

N69-36123# Haskins Labs., Inc., New York.
DISCRIMINATION OF THREE-FORMANT NASAL-VOWEL SYLLABLES, PART 3
Erica Garcia *In its* Speech Res. Jun. 1968 p 143–153 refs (See N69-36117 21-04)
Avail: CFSTI

The identification of synthetic nasal-vowel syllables based on three-format vowel stimuli was discussed. It was found in experiments that labeling of synthetic nasals was equally sharp in CV and VC position, and that good labellers showed as abrupt a cross over from one nasal category to the other as was observed earlier in the case of voiced stops. Results agree reasonably well with predicted results. Author

N69-36204*# Naval Medical Research Inst., Bethesda, Md. Dept. of Microbiology.
EFFECTS OF HIGH AND LOW BAROMETRIC PRESSURES ON SUSCEPTIBILITY AND RESISTANCE TO INFECTION
Quarterly Status Report, 1 Apr.–30 Jun. 1969
Francis B. Gordon and James D. Gillmore 30 Jun. 1969 14 p
(NASA Order R-21-010-010)
(NASA-CR-105588; A-3061A(AS-1); QSR-16) Avail: CFSTI CSCL 06S

Three experiments in which mice were subjected to simulated space cabin atmospheres (70% O_2 in N_2, 5 psia) before or after exposure to aerosol challenge with influenza virus did not confirm the impression obtained from an earlier experiment, i.e., that the 70% O_2 induced a more severe disease. The last three experiments gave evidence for a less severe infection in the simulated space cabin environment. A comparison of the evolution of the infection in the experiments with discrepant results shows a difference, and suggests that an unrecognized factor may be responsible, rather than random chance. Groups of hypoxic mice (air, 7.3 psia) were included in the experiments. Additional evidence was obtained for protection against influenzal infection by this environmental condition. In a single experiment influenza-infected mice exposed to hyperoxia (77% O_2, 1 atm) had a more severe infection than did the controls in air. By careful attention to standardization of all possible controllable factors in an experiment with A/HeJ mice in which pulmonary adenomas were induced by intravenous inoculation of dibenz-anthracene, a much better within-group range of variability was achieved. There was a 30% greater incidence of tumors in the mice exposed to 100% O_2 for 48 hours. Author

N69-36231*# Techtran Corp., Glen Burnie, Md.
CLINICAL RESEARCH ON THE RELATIONSHIP BETWEEN BASIC GUSTATORY SENSATIONS, GASTRIC SECRETION, GLYCEMIA, AND SENSE OF APPETITE [RICERCHE CLINICHE SUI RAPPORTI TRA SENSAZIONI GUSTATIVE FONDAMENTALI, SECREZIONE GASTRICA GLICEMIA E SENSE D'APPETITO]
Aldo Bellomo Washington NASA Sep. 1969 15 p refs Transl. into ENGLISH from Minerva Med. (Turin), v. 32, 1941 p 410–417
(Contract NASw-1695)
(NASA-TT-F-12513) Avail: CFSTI CSCL 06S

A presentation of mechanisms which influence gastric secretion and affect the appetite are given. It is shown that both the nervous and chemicohumoral systems act as stimuli to start secretion. Also examined are the influences of humoral, neurovegetative, and psychic mechanisms. Experiments were performed with human subjects. E.H.W.

N69-36294*# Neurosciences Research Program, Brookline, Mass.
NEURONAL FIBROUS PROTEINS: A REVIEW BASED ON TWO NRP CONFERENCES
Francis O. Schmitt and Frederick E. Samson, Jr. 15 Oct. 1968 110 p refs Sponsored in part by the Rogosin Foundation, and the Neurosciences Research Foundation Its Neurosci. Res. Prog. Bull., Vol. 6, No. 2
(Grants NsG -462; Nonr(G)-00014-68; NIH GM-10211-07)
(NASA-CR-105593) Avail: CFSTI CSCL 06P

Abstracts on neuronal fibrous proteins are presented, based on two conferences. Subjects include: (1) molecular biology of neuronal proteins, (2) general morphology of microtubules, (3) functional patterns of microtubules, (4) protein chemistry of microtubules, (5) characterization of microtubules, neurofilaments, and cross bridges in various neuronal types, (6) relations between neurofibrils, microtubules, and neurofilaments in degeneration, (7) fibrous constituents of cells, (8) physicochemical properties of neurofilaments, (9) mechanochemical coupling in muscle, and (10) fibrous constituents in some pathological states. The tubular structures in sensory transduction is discussed, and a bibliography is included. F.O.S.

N69-36305*# University City Science Center, Philadelphia, Pa.
THE MOLECULAR BIOLOGY OF NITROGEN FIXING NODULES IN COMMON LEGUMES Annual Report
Elizabeth Thorogood 15 Jul. 1969 9 p
(Grant NGR-39-030-004)
(NASA-CR-105674) Avail: CFSTI CSCL 06C

An investigation into heme protein production in pea nodules was conducted. Of several peas investigated, the soybean seemed to produce more of the substance than the others. It also shows more stable qualities than other pea nodules, and seems to be easier to manipulate. In peas it was noted that the protein structure cannot hold onto the heme over long periods. Several methods for this process were also investigated, and it was concluded that the best method was to extract the substance in an atmosphere of carbon monoxide combined with hydrogen, extract the substance in mildly acid buffer, and dialyze the ammonium sulfate heme protein paste heme against Tris buffer. Distilled water must also be used in the process. E.H.W.

N69-36350*# National Aeronautics and Space Administration, Washington, D.C.
FERTILIZABILITY OF THE EGG OF HYLA ARBOREA JAPONICA WITH SPECIAL REFERENCE TO THE CHANGE OF JELLY ENVELOPE
Ch. Katagiri Sep. 1969 11 p refs Transl. into ENGLISH from Zool. Mag. (Tokyo), v. 72, 1963 p 23–28
(NASA-TT-F-12333) Avail: CFSTI CSCL 06C

The change of the jelly envelopes of the egg of *Hyla arborea japonica* was studied in relation to the maintenance of its fertilizability. The egg is surrounded by a vitelline membrane and four layers of jelly envelopes. When inseminated, spermatozoa penetrating into the jelly come to a standstill upon contact with the jelly membrane. After a short pause of 1–2 seconds, they again start to penetrate through and reach the vitelline membrane. Fertilizability of the egg can be retained for a considerable time, at least six hours, in De Boer's solution, whereas in tap water it is retained at longest for 30 minutes and is completely lost within 45 minutes after immersion. It was found that spermatozoa cannot penetrate through the jelly membrane of the eggs pretreated for a long time with tap water. Author

N69-36366*# California Univ., Los Angeles. School of Medicine.
HISTOPATHOLOGICAL EVIDENCE FOR PULMONARY EMBOLI IN EXPERIMENTAL DECOMPRESSION SICKNESS DIAGNOSED BY RADIOISOTOPIC LUNG SCANNING
A. T. K. Cockett, S. M. Pauley, J. C. Saunders, and A. P. Roberts [1968] 10 p refs
(Grant NGL-05-007-003; Contract NRO-0014-66-C0295)
(NASA-CR-105591) Avail: CFSTI CSCL 06S

Mongrel dogs underwent experimental overcompression and decompression in test chambers at barometric pressures of 73.5 psig and 7 psig respectively. These tests proved lethal for the dogs, but provided useful information. The tests provide useful histopathological evidence for the presence of pulmonary embolization. The emboli was detected by serial scanning of the lung. A biopsy showed pulmonary edema and hemorrhage in the lung tissues. A biopsy of the cold areas was also performed. E.H.W.

N69-36378*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Lab.
BIOPHYSICAL EVALUATION OF THE HUMAN VESTIBULAR SYSTEM Status Report, Jan. 1968–Jun. 1969
J. L. Meiry and L. R. Young Jun. 1969 40 p
(Grant NGR-22-009-156)
(NASA-CR-105596; MU-69-3) Avail: CFSTI CSCL 06S

The disparity between the experimentally evaluated time constants of objective and subjective responses to angular accelerations and the hydromechanical time constants of the semicircular canals is accentuated by a rigorous analysis of the semicircular canals as a damped hydromechanical angular

accelerometer. The dynamic response characteristics of the semicircular canals to angular acceleration are shown to be an order of magnitude faster than can be observed by nystagmus and subjective responses to vestibular stimulation. In addition, it is shown that roller pump action of the flexible canalicular duct can maintain an adequate pressure differential across the cupula to give it a constant deflection. This is physiologically equivalent to a constant angular acceleration stimulus, and offers a plausible explanation for the continuous nystagmus responses that are provoked by rotation at a constant angular velocity about an axis which is not colinear with an applied acceleration field. Author

N69-36433*# Oakland Univ., Rochester, Mich. School of Engineering.

BIOSYSTEMS ENGINEERING RESEARCH Quarterly Progress Report

J. E. Gibson, R. H. Edgerton, R. E. Haskell, and J. C. Hill 30 Jul. 1969 51 p refs

(Grant NGR-23-054-003)

(NASA-CR-105653; QPR-1) Avail: CFSTI CSCL 06B

Equations of motion were derived by means of the Lagrange equations for a seven-element stick man, part of a postural control system. Experiments to determine the force–velocity characteristics of human muscles are mentioned in this connection. Work is described on two problems related to bio-optics. The first study deals with the design of a continuously variable focusing system which could be used either to replace bifocal lenses, allow bifocal contact lenses, or provide an artificial cornea. The second study is an attempt to describe and model the cornea. Liquid crystals were tentatively chosen as the media for these purposes because their sensitive optical properties can be readily altered by magnetic, electrical, or mechanical means. An exploratory study was made of the use of coherent optical processing techniques for the rapid analysis of large quantities of experimental biological data. The approach is to characterize biological photomicrographs as random signals from which quantitative statistical information can be obtained. Power spectrum and autocorrelation measurements made for the purpose of this study are described, and a lensless optical processor for signal analysis was designed. K.W.

N69-36436*# George Washington Univ., Washington, D.C. Medical Center.

SCIENTIFIC PUBLICATIONS OF THE BIOSCIENCE PROGRAMS DIVISION. VOLUME 3: EXOBIOLOGY, SECOND EDITION

Frances Hong and Jean Pulliam 31 Aug. 1968 154 p refs

(Contract NSR-09-010-027)

(NASA-CR-103224) Avail: CFSTI CSCL 06C

This volume contains 715 citations arranged chronologically and alphabetically by author. Publications appearing in serial literature, monographs, and books during the period from 1960 through 1967 are listed. The information is also presented in the rearranged form of a permuted title index, an author index, and a listing of senior authors and laboratory addresses. A list of journals publishing exobiology articles is included. K.W.

N69-36471# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BLASTOMOGENIC PROPERTIES OF INDUSTRIAL METALS AND THEIR COMPOUNDS

P. P. Dvizhkov 6 Mar. 1969 21 p refs Transl. into ENGLISH from Arch. Patol. (Moscow), v. 29, no. 3, 1967 p 3–11

(AD-688689; FTD-MT-24-452-68) Avail: CFSTI CSCL 6/10

A review of the literature on some important industrial metals and their compounds (chromium, nickel, cobalt, beryllium, zinc, iron, aluminum, and metallic mercury) with special reference to their effects on the lungs indicated that some of the metals (nickel and chromium) are definitely blastomogenic, while others (beryllium and cobalt) are potentially so. Iron, zinc, and aluminum have not been clearly implicated. The author notes the sparseness of studies on morphological changes in humans and animals after exposure to the metals. Little attention has been paid to the pretumor, initial, and subsequent stages of the disease. There is also need for cytological studies. Author (TAB)

N69-36476# Joint Publications Research Service, Washington, D.C.

PROBLEMS OF WEIGHTLESSNESS DISCUSSED

10 Jul. 1969 23 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 3, 1969 p 323–338

(JPRS-48383) Avail: CFSTI

CONTENTS:

1. SOME PROBLEMS OF WEIGHTLESSNESS IN SPACE MEDICINE (A SURVEY) P. V. Vasilyev et al p 1–15 refs (See N69-36477 21-04)

2. SIMULATION OF MAN'S MOVEMENTS IN WEIGHTLESSNESS AND IN A WATER ENVIRONMENT FROM BIOMECHANICAL POSITIONS N. F. Chekirda et al p 16–22 refs (See N69-36478 21-04)

N69-36477# Joint Publications Research Service, Washington, D.C.

SOME PROBLEMS OF WEIGHTLESSNESS IN SPACE MEDICINE A Survey

P. V. Vasilyev et al *In its* Probl. of Weightlessness in Space 10 Jul. 1969 p 1–15 refs (See N69-36476 21-04)

Avail: CFSTI

Space flights lasting up to two weeks induce a number of autonomic changes referable to the main physiological systems that are not pathological and that are indicative of development of compensatory-adaptive reactions in the organism under unusual living conditions. At different stages of space flight, changes are noted in parameters characterizing the function of the cardiovascular system, respiration, as well as metabolism and expenditure of energy. The extent of such reactions is determined largely by the individual distinctions of the astronauts. The results of laboratory investigations indicate that it is possible, using a number of physical methods and pharmacological agents, to increase orthostatic stability and resistance to G-forces during the period following prolonged hypodynamia and immersion. Author

N69-36478# Joint Publications Research Service, Washington, D.C.

SIMULATION OF MAN'S MOVEMENTS IN WEIGHTLESSNESS AND IN A WATER ENVIRONMENT FROM BIOMECHANICAL POSITIONS

N. F. Chekirda et al *In its* Probl. of Weightlessness in Space 10 Jul. 1969 p 16–22 refs (See N69-36476 21-04)

Avail: CFSTI

A cyclogrammetric study was made of internal coordination structure of slow and rapid movements of the human hand under conditions of weightlessness, under the ordinary force of gravity, and when immersed in water. Biomechanical analysis was made of formation of movements under various environmental conditions. It was established that in a water environment the internal coordinational structure of movements is more complex than under the usual force of gravity and in weightlessness. There are negligible differences in slow movements with respect to muscular exertion and appearance in water and weightlessness. This permits successful simulation in water of performance of the meaningful aspect of professional work operations and the sequence of their performance in space. Author

N69-36483# George Washington Univ., Alexandria, Va. Human Resources Research Office.
FACTORS IN PREDICTING ARMY AVIATOR PERFORMANCE: BIRTH ORDER AND PARTICIPATION IN DANGEROUS SPORTS AND ACTIVITIES
Peter R. Prunkel May 1969 15 p refs Presented at Southeastern Psychological Assoc. Ann. Meeting, New Orleans, Feb. 1969
(Contract DAHC19-69-C-0018)
(AD-688812; HumRRO-PP-13-69) Avail: CFSTI CSCL 5/10

From previous research it was hypothesized that firstborns would tend to avoid the potential dangers of Army aviation, but that firstborn-volunteers would not differ from later-born volunteers in terms of previous participation in dangerous sports and activities. Data were used from the Background Activities Inventory of 395 aviation warrant officer trainees, to test for birth-order effect by comparing first- and second-borns from the same-size families. Although there were significantly more first- than second-borns, reasons that the finding may be spurious are discussed. First- and second-born trainees did not differ on measures of exposure to dangerous sports and activities or confidence. Neither pass-fail from flight training nor previous college attendance showed a birth-order effect. Author (TAB)

N69-36488*# Cornell Univ., Ithaca, N.Y.
NATURAL SELECTION OF MICROORGANISMS IN EXTREME ENVIRONMENTS Final Report
M. Alexander Jul. 1969 9 p
(Grant NGR-33-010-013)
(NASA-CR-105657) Avail: CFSTI CSCL 06M

The natural selection of microorganisms exposed to drought and starvation was studied by isolating bacteria susceptible and resistant to these extreme environmental conditions, and the ability of each to survive under environmental stress was examined. The spore formers were eliminated by heat treatment. The organisms that survived the drought stress for more than 15 days were considered as resistant and those that perished within one to four days were designated susceptible. It was found that: certain gram negative rods were capable of maintaining viability for periods of 60 days; the resistance to drought was effected by the age of the organisms; and the ability to resist extreme dryness increased after adaptation by mutation or nonganetic changes. The starvation-resistant bacteria were found to have a high content of PHB, whereas the PHB level in the susceptible cells was uniformly low. F.O.S.

N69-36545# Israel Program for Scientific Translations, Ltd., Jerusalem.
VEGETATION OF THE FAR NORTH OF THE USSR AND ITS UTILIZATION. PART 6: VASCULAR PLANTS OF THE SIBERIAN NORTH AND THE NORTHERN FAR EAST
B. A. Tikhomirov ed. et al 1969 341 p refs Transl. into ENGLISH from the book "Rasteniya Severa Sibiri i Dalnego Vostoka. Part 6: Rastitelnost Krainego Severa SSSR i ee Osvoenie" Moscow, Nauka, 1966 Published for US Dept. of Agr. and NSF *Its* Cat. No. 5133
(TT-68-50340) Copyright. Avail: CFSTI

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1. THE FLORA OF TIKSI BAY (ARTIC YAKUTIA) B. A. Tikhomirov et al p 4–50 refs (See N69-36546 21-04)
2. A LIST OF VASCULAR PLANTS OF MUOSTAKH ISLAND (BUORKHAYA BAY, ARCTIC YAKUTIA) O. V. Rebristaya p 51–54 ref (See N69-36547 21-04)
3. VASCULAR PLANTS OF AION ISLAND (CHAUN BAY) V. R. Filin et al p 55–73 refs (See N69-36548 21-04)
4. THE FLORA OF THE BERING COAST OF CHUKCHI PENINSULA B. A. Tikhomirov et al p 74–105 refs (See N69-36549 21-04)
5. FLORA OF THE EXTREME EAST OF CHUKCHI PENINSULA (UELEN TOWN-CAPE DEZHNEV) T. G. Derviz-Sokolova p 106–144 refs (See N69-36550 21-04)
6. THE FLORA OF THE VERKHOYANSK MOUNTAINS I. D. Kildyushevskii p 145–164 refs (See N69-36551 21-04)
7. FLORA OF THE VICINITY OF THE EXCAVATION OF THE TAIMYR MAMMOTH B. A. Tikhomirov p 165–191 refs (See N69-36552 21-04)
8. FLORA OF THE MOUNTAIN AND PLAIN TUNDRAS AND OPEN FORESTS OF THE URALS K. N. Igoshina p 192–340 refs (See N69-36553 21-04)

N69-36546# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE FLORA OF TIKSI BAY (ARCTIC YAKUTIA)
B. A. Tikhomirov et al *In its* Vegetation of the Far North of the USSR and its Util., Pt. 6 1969 p 4–50 refs (See N69-36545 21-04)
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Information concerning the flora in the vicinity of the town of Tiksi, located in the lower area of the Lena River, is presented. Following a brief physico-geographical description of the region, the topographical distribution and types of plant life are treated. In defining the latitudinal-geographical features, the flora are designated as Arctic in type; the specific character is considered plain-mountain or coastal-mountain. A.C.R.

N69-36547# Israel Program for Scientific Translations, Ltd., Jerusalem.
A LIST OF VASCULAR PLANTS OF MUOSTAKH ISLAND (BUORKHAYA BAY, ARCTIC YAKUTIA)
O. V. Rebristaya *In its* Vegetation of the Far North of the USSR and its Util., Pt. 6 1969 p 51–54 ref (See N69-36545 21-04)
Copyright. Avail: CFSTI

A list of plants collected on Muostakh Island, situated in Buorkhaya Bay near Tiksi, is given. The island is made up of a strip of dry land about 19 km in length and 0.2 to 10 km in width, extending longitudinally NNW to SSE. Originally joined to the mainland as part of the Bykov Peninsula, it became detached under the action of strong seas and is characterized by the presence of a fossil-ice stratum concealed beneath a soil layer in all except the northern extremity. Nearly all of the surface is covered by polygonal mud-crack bogs in different stages of development, the disintegration of which results in the formation of hummock-baidzharakhi plants over the littoral area of the island. The moss and low-shrub patchy tundras characteristic of the Tiksi area are not present. A.C.R.

N69-36548# Israel Program for Scientific Translations, Ltd., Jerusalem.
VASCULAR PLANTS OF AION ISLAND (CHAUN BAY)
V. R. Filin et al *In its* Vegetation of the Far North of the USSR and its Util., Pt. 6 1969 p 55–73 refs (See N69-36545 21-04)
Copyright. Avail: CFSTI

A list of plant life on Aion Island is presented, as represented by a 1958 expedition along the western and southern coasts and specimens collected prior to that date. The island is essentially a low plain with many rivers and lakes composed of Quaternary lacustrine-alluvial loamy deposits; the northwest, central and several other areas are characterized by sandy deposits forming low dunes. The southern and western coasts break off abruptly at the sea as steep escarpments separated from the waterline by sandy or silty marine terraces. The climate is maritime, and widely distributed areas of permafrost are found. Vegetation is represented by various tundra formations, of which polygonal sedge-hypnum bogs are widespread in regions of low relief. A.C.R.

N69-36549# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE FLORA OF THE BERING COAST OF CHUKCHI PENINSULA

B. A. Tikhomirov et al *In its* Vegetation of the Far North of the USSR and its Util., Pt. 6 1969 p 74–105 refs (See N69-36545 21-04)

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The results of research over the period 1956–1958 and in 1962 are discussed as related to the flora and vegetation in thermal springs and that in other parts of the peninsula's eastern coast. A brief historical account is given of expeditions into this area, which is of particular interest in analyzing American-Asiatic biological links and has significant influence on Arctic flora and fauna. The topography of the region is also treated, since the Asiatic shore of the Bering Sea, dissected by numerous fjord-shaped bays receiving the mass flow from small rivers and streams, affords an excellent base for plant settlement of the Chukchi mountain system. At the same time, the open beaches of the Bering Sea provide a sanctuary for plants whose settlement is related to the presence of sea waters. The diverse ecological conditions and the open habitats thus give unlimited possibilities for species migration and enable the existence of contemporary floral species as well as plants from previous epochs. A.C.R.

N69-36550# Israel Program for Scientific Translations, Ltd., Jerusalem.

FLORA OF THE EXTREME EAST OF CHUKCHI PENINSULA (UELEN TOWN-CAPE DEZHNEV)

T. G. Derviz-Sokolova *In its* Vegetation of the Far North of the USSR and its Util., Pt. 6 1969 p 106–144 refs (See N69-36545 21-04)

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Results of 1958 and 1959 summer expeditions are described, which provide a more complete characterization of the area and give new information on the flora of both the Chukchi Peninsula and the U.S.S.R. as a whole. Brief notes are included on the ecology and biology of the individual species; for rare species, information is also given on the place and date of collection, as well as the phenologic phase. The studies were confined to a small area in the easternmost corner, from the town of Inchoun to Puoten Bay. Collections were made in valley tundras, on slopes of small unknown sopkas, and on the slope of Uelenei sopka, which forms the northwestern part of the Dzhnev massif. The physico-geographical features of the area are described, and the types of habitat are classified based on geomorphological conditions. This classification resulted from the observation that plant associations are constantly under the influence of excessive moisture conditions, and that the content of soil moisture in the area large depends upon local relief. Families and genera of flora are listed according to Engler's classification and their general characteristics analyzed. A.C.R.

N69-36551# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE FLORA OF THE VERKHOYANSK MOUNTAINS

I. D. Kildyushevskii *In its* Vegetation of the Far North of the USSR and its Util., Pt. 6 1969 p 145–164 refs (See N69-36545 21-04)

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An analysis of plant collections made in the Tompo District along the upper reaches of the Tompo, Narigandy, and Bryungyade rivers is presented. Species from previous expeditions are also included in order to obtain a more exhaustive representation and to fill in a gap in knowledge concerning the overall flora population of the Verkhoyansk Range. The investigated region has a mountainous terrain rising to a height of 2000 m above sea level, with individual peaks up to 2500 m. The greater part of the area is situated above the timberline and comprises screes almost devoid of vegetation. Lichens and low shrub growth only develops on the more gentle slopes. The small river valleys are widely distributed with high terraces of lichen tundras; lower areas have terraces with low shrub tundras. Along the river channel there is usually a wide belt of pebbles with willow growth. A list of 267 collected species and their distribution is included. A.C.R.

N69-36552# Israel Program for Scientific Translations, Ltd., Jerusalem.

FLORA OF THE VICINITY OF THE EXCAVATION OF THE TAIMYR MAMMOTH

B. A. Tikhomirov *In its* Vegetation of the Far North of the USSR and its Util., Pt. 6 1969 p 165–181 refs (See N69-36545 21-04)

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The results of an expedition to the Taimyr Peninsula, the northernmost European and global continental promontory, are presented. The area in which the Taimyr mammoth was found was chosen for the sample collection, since no botanist had visited it before. The plant associations are characterized in general terms to give a clearer understanding of the origins and development of the flora. The principal plant groupings are classified as follows: (1) cottongrass-moss tundras; (2) cottongrass-sedge patchy moss tundras, which constitute a stage in the disintegration process of preceding associations under the effect of solifluction and patch formation; (3) dryad-sedge moss patchy tundras, representing a further stage in plant aggregation evolution that occurs only on sectors with better drainage; and (4) sedge-willow moss patchy tundras, also considered as a stage in the degradation of cottongrass tundras. A list of 118 species collected during the expedition is given. It was concluded that the relatively profound transformation of plant cover observed was caused by a corresponding alteration of the entire physico-geographic complex; in late post-glacial times, this proved too severe for the continued existence of many plants. A.C.R.

N69-36553# Israel Program for Scientific Translations, Ltd., Jerusalem.

FLORA OF THE MOUNTAIN AND PLAIN TUNDRAS AND OPEN FORESTS OF THE URALS

K. N. Igoshina *In its* Vegetation of the Far North of the USSR and its Util., Pt. 6 1969 p 182–340 refs (See N69-36545 21-04)

Copyright. Avail: CFSTI

A list of flora, based on collections in a Soviet botanical herbarium and those obtained from expeditions covering the period 1925–1965, is presented. A brief historical account is also given of previous investigations in the Urals from the 18th century to the modern era. The list includes 769 species of 245 genera pertaining to 53 families; it encompasses the flora of Ural mountain and plain tundras, as well as those of mountain and plain open-forest zones extending to the borders of the closed forest. Over a range of 2000 km from north to south, the area and character of the goltsys with high-mountain flora exhibit marked change. For this reason, five sectors, as adopted by geologists, are used in reviewing the distribution of plant species. A.C.R.

N69-36660# Atlantic Research Corp., Alexandria, Va.

THE FLAMMABILITY OF SKIN AND HAIR IN OXYGEN-ENRICHED ATMOSPHERES Final Report, 1 Jun. 1967–1 Jun. 1968

Robert L. Durfee Brooks AFB, Tex. AF School of Aerospace Med. Dec. 1968 41 p refs

(Contract F41609-68-C-0013)

(AD-688920; SAM-TR-68-130) Avail: CFSTI CSCL 13/12

The flammability of hair and skin from white suckling pigs and from humans was studied in atmospheres ranging in oxygen concentration from 20.9% (air) to 100%. Neither pigskin nor human skin would support combustion in pure oxygen at 258 mm. Hg except in the presence of an artifact consisting of exposed subdermal fat and local depletion of heat sink capability. Although pig bristles and human hair burn rapidly in pure oxygen, differences observed in flame spead rates and burning times indicate that skin of suckling pigs is not an adequate simulant for human skin in terms of response to an ignition source in pure oxygen. Methods of protection against ignition were studied with pigskin samples. The helium concentration necessary to prevent flame spread at 1 atm. total pressure is 75% by volume. Salves and creams are effective against flame spread when the amounts applied are much larger than those normally used. The values obtained from the present work on unshaved pigskin samples to determine flame spread rate and critical helium concentration (for zero flame spread) are completely consistent with reported values for other types of combustibles. Author (TAB)

N69-36719# Naval Aerospace Medical Inst., Pensacola, Fla.
ACQUIRED BUNDLE BRANCH BLOCK IN THE NAVAL AVIATOR POPULATION
Raphael F. Smith, David H. Jackson, J. Warren Harthorne, and Charles A. Sanders 28 Feb. 1969 14 p refs
(AD-688118; NAMI-1062) Avail: CFSTI CSCL 6/5

Twenty-eight naval aviators (median age 40 years) whose electrocardiograms changed from a normal pattern to bundle branch block were studied in order to assess the attendant risk. Twenty-two of the men had right bundle branch block (RBBB) and six had left bundle branch block (LBBB). In 25 men the abnormality was noted on a routine ECG at the time of annual physical examination. Follow-up information was available for all members of the group and represented 100 patient-years of observation. Selective coronary angiography was done in seven men and coronary artery disease was noted in one patient with LBBB. Six men had normal coronary arteries. One patient, age 44, died eight months after his ECG changed to RBBB. Extensive coronary artery disease was present at autopsy. A total of three men in the bundle branch block group had definite evidence of coronary heart disease. In two men RBBB appeared after chest trauma. The prevalence of coronary heart disease was higher in the bundle branch block group than in a cohort of 649 naval aviators of similar age. In 23 of the men the etiology of the bundle branch block was not determined. It is concluded that acquired bundle branch block is frequently, but not invariably, associated with a good prognosis in the young male patient. Author (TAB)

N69-36741*# California Univ., Berkeley.
CO-EXISTENCE OF LIPID AND GAS EMBOLI IN EXPERIMENTAL DECOMPRESSION SICKNESS
A. T. K. Cockett, S. M. Pauley, J. C. Saunders, and F. M. Hirose [1968] 9 p refs
(Grant NGR-05-007-003; Contract NRO-0014-66-C0295)
(NASA-CR-105751) Avail: CFSTI CSCL 06S

Tissue sectioning was performed on the lungs of mongrel dogs overcompressed to 165 feet, maintained at depth for 60 minutes, and then decompressed to surface. Oil-red-O stains were made of treated and untreated animals. Treatment consisted of dextran or intravenous heparin. The results show: (1) Lipid embolization appears to play a major role in the genesis of decompression sickness. (2) Evidence is found for the coexistence of lipid emboli and gaseous emboli. (3) Heparin or dextran, effective lipemic clearing agents, are beneficial in treating experimental decompression sickness. (4) A combinded therapeutic approach, using recompression and dextran, should be employed in treating human decompression sickness. Heparin may serve as a substitute in selected instances. Author

N69-36773*# Techtran Corp., Glen Burnie, Md.
THE EFFECT OF VITAMINS B1 AND B2 (LACTOFLAVIN) ON THE WATER TEST AMONG NORMAL CHILDREN [DIE WIRKUNG DER VITAMINE B1 UND B2 (LACTOFLAVIN) AUF DIE WASSERPROVE BEI NORMALEN KINDERN]
I. Gatto Washington NASA Sep. 1969 7 p refs Transl. into ENGLISH from Klin. Wochschr. (Berlin), v. 18, 1939 p 303-305
(Contract NASw-1695)
(NASA-TT-F-12502) Avail: CFSTI CSCL 06P

This article discusses the effect of vitamins B_1 and B_2 (lactoflavin) on the water test among normal children. The results of these examinations among normal children can be summarized as follows: 1. Vitamin B_1 does not show any effect on the water test. 2. Vitamin B_2 results in a reduced diuresis during the hour following the administration of the vitamin; however, this effect is compensated during the second and third hours of the water test. 3. Vitamin B_2 has the same effect on the Salyrgan and Diuretin diuresis. Author

N69-36774*# Techtran Corp., Glen Burnie, Md.
THE BEHAVIOR OF BLOOD SUGAR LEVELS DURING REPEATED AND VARIOUS KINDS OF ENTERIC SUGAR SUPPLY AND ITS SIGNIFICANCE FOR THE FUNCTION OF THE LIVER [UBER DAS VERHALTEN DES BLUTZUCKERSPIEGELS BEI WIEDERHOLTER UND VERSCHIEDENER ART ENTERALER ZUCKERZUFUHR UND DESSEN BEDEUTUNG FUR DIE LEBERFUNKTION]
Karl Traugott Washington NASA Sep. 1969 6 p ref Transl. into ENGLISH from Klin. Wochschr. (Berlin), v. 1, no. 18, 29 Apr. 1922 p 892-894
(Contract NASw-1695)
(NASA-TT-F-12516) Avail: CFSTI CSCL 06P

Liver function in sugar utilization is studied by testing blood sugar level in a large population after injection of 100 g dextrose or levulose. It is observed that following the enteric introduction of a nutriment so suitable for the body as dextrose, results occur that are otherwise seen usually only in the case of parenteral introduction of alien substances, such as for example, a rejection of a rather large amount of albumen goes along with an increased degree of albumen breakdown. Author

N69-36776# School of Aerospace Medicine, Brooks AFB, Tex.
BIOASTRONAUTICS AND THE EXPLORATION OF SPACE Conference Proceedings
Charles H. Roadman, ed., Hubertus Strughold, ed., and Roland B. Mitchell, ed. Nov. 1968 610 p refs Presented at the 4th Intern. Symp., San Antonio, 24-27 Jun. 1968
(Contract AF 41(609)-67-C-0034)
(AD-687893) Avail: CFSTI CSCL 6/3

Conference papers are presented on the development of aerospace medicine, and the relationship between astronautics and planetary exploration. For individual titles, see N69-36777 through N69-36803.

N69-36779# California Univ., La Jolla.
SOME REMARKS ON THE EVOLUTION OF THE ATMOSPHERES AND THE OCEANS
Harold C. Urey *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 25-45 refs (See N69-36776 21-04)
(UCSD-34) Avail: CFSTI

Recent chemical, paleontological, and biological evidence on the evolution of the earth's atmosphere and oceans is presented. Topics include: the origin of the earth; its early surface; composition of the primitive atmosphere and oceans; variation of the atmosphere with time; and the origin of life. A.C.R.

N69-36780*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHEMICAL EVOLUTION AND THE ORIGIN OF LIFE
Cyril Ponnamperuma *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 47–61 refs (See N69-36776 21-04)
Avail: CFSTI CSCL 06C

Experimental laboratory research into the chemical sequence of events which led to the appearance of the first replicating molecules is summarized, and it is shown that these two stages could have taken place on the primordial earth before the appearance of life. The two events are: (1) origin of the micromolecules, or monomers; and (2) condensation of the micromolecules into macromolecules, or polymers, capable of replication. Specific experiments were aimed at simulation of primitive atmospheres, and condensation reactions. These procedures indicated that wherever suitable conditions exist, organic compounds of biological significance can be synthesized. These results lend support to the hypothesis of chemical evolution and to belief in the existence of extraterrestrial life. A.C.R.

N69-36782# Universidad Peruana de Ciencias Medicas y Biologicas, Lima (Peru).
THE ANDEAN MAN
Alberto Hurtado *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 83–93 refs (See N69-36776 21-04)
Avail: CFSTI

The adaptive processes required for the existence of prehistoric Andean civilization at altitudes up to 4200 m are discussed in light of recent research into high altitude physiological responses. It is emphasized that hypoxia is the most critical factor in human adaptation to such an environment. The adaptive process is considered in two categories: (1) those which act along the total pO_2 gradient, from inspired air to mixed venous blood, introducing a large economy in the fall of the gradient; and (2) those which operate at tissue level, favoring the acquisition and utilization of oxygen. Several clinical aspects of these processes are briefly mentioned, and it is recommended that further study be made into this type of acclimatization, due to lack of uniform agreement regarding the pathogenesis of some of the adaptive processes. A.C.R.

N69-36784# School of Aerospace Medicine, Brooks AFB, Tex.
LIFE SUPPORT (SURVIVAL) IN SPACE
A. G. Swan *In its* Bioastronaut. and the Exploration of Space Nov. 1968 p 113–132 refs (See N69-36776 21-04)
Avail: CFSTI

The requirements for survival during prolonged space flights are discussed, and the factors involved in space environmental control are analyzed. The term environment in this context is defined as the atmosphere, gravitational forces, and solar radiation. Weightlessness conditions, one of the primary environmental concerns of future space flight, is treated as to its physiological effects and methods of counteracting them. A list of tolerable atmospheres for selection, and possible contaminants from the crew, materials, and equipment malfunctions are suggested. Mention is also made of the problems of oxygen toxicity, rapid decompression, and fire hazards. It is concluded that improved technology, coupled with increased flight experience during recent years, enables the undertaking of manned flights of 30 to 45 days with reasonable assurance of survival. It is also recommended that animal flights of 90 to 180 days be initiated, giving particular attention to studying cellular effects caused by total space environment for prolonged periods. A.C.R.

N69-36787# Air Force Systems Command, Washington, D.C.
BIOASTRONAUTICS AND ORBITING SPACE STATIONS
James Ferguson *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 179–189 (See N69-36776 21-04)
Avail: CFSTI

The physiological and psychological problems related to man's adaptation to the space environment are discussed, and the economic feasibility of initiating a manned orbital space station within the next decade is treated from the viewpoint of overall national priorities. The technical achievements toward realization of a space station during the past few years are reviewed, as well as several programs designed to contribute a better knowledge of the factors involved in such an undertaking. Included are the S IV R workshop and studies leading toward a Manned Orbiting Laboratory (MOL). Economic consideration involved in assuring the survival and health of astronauts during their assignment to a space station are evaluated. Particular attention is given to the recommended duration of the mission, station size, extent of automated equipment, simulation of earth atmospheric conditions, and weightlessness. A.C.R.

N69-36788*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ORBITAL FLIGHT RESULTS
Charles A. Berry *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 191–211 refs (See N69-36776 21-04)
Avail: CFSTI CSCL 06S

Physiological responses and changes in man's functional capabilities during orbital flight are summarized, based on information collected from the Mercury, Gemini, and Apollo Programs. Significant features of the space environment which must be taken into account include the zero gravity state, an altered ionizing radiant flux from that encountered within the earth's atmosphere; and an altered exposure to sunlight and darkness. The physiological effects of extravehicular activity are also considered. Finally, steps toward longer duration flights, such as envisioned by the Apollo Applications Program in the form of a manned orbiting workshop, are discussed, and suggestions are made for the biomedical data which could be gained from such a project. It is concluded that the health and adaptation of astronauts cannot yet be predicted for flights durations of more than six months, and that orbital missions for this purpose should be conducted with at least six crewmen in order to achieve an adequate sampling. A.C.R.

N69-36794# School of Aerospace Medicine, Brooks AFB, Tex.
THE HUMAN EYE IN SPACE EXPLORATION
James F. Culver *In its* Bioastronaut. and the Exploration of Space Nov. 1968 p 387–397 refs (See N69-36776 21-04)
Avail: CFSTI

Weightlessness and its effects on vision are discussed and related to visual requirements for lunar landing and exploration under the Apollo program. Past experiences in manned space flight have demonstrated that the astronaut can adapt to changes in lighting and difficulties in distance judgment. Two inputs are needed: (1) the absolute size of the viewed object; and (2) the rate of closure. If both or either is known, proper training results in accurate distance judgment utilizing other cues. A.C.R.

N69-36795# School of Aerospace Medicine, Brooks AFB, Tex. Plans and Operations Div.
BIODYNAMIC ENVIRONMENTS IN SPACEFLIGHT
Neville P. Clarke *In its* Bioastronaut. and the Exploration of Space Nov. 1968 p 399–419 refs (See N69-36776 21-04)
Avail: CFSTI

When the effects of mechanical forces associated with space flight on crewmen are evaluated, two sets of boundary conditions are pertinent: (1) those which establish the mechanical force environments; and (2) those which establish human limits to survive and perform adequately in these environments. This complex relation between man and the space system he operates is analyzed, with attention focused on two major effects of biodynamic environments on human performance. These are: (1) effects of increasingly longer exposure to weightlessness and other factors on subsequent response; and (2) effects of extremely sustained conditions of acceleration, vibration, and impact forces which occur under emergency conditions. It is concluded that biodynamic environments predicted for nominal performance on future missions are not necessarily more severe than those encountered on previous flights. The major unknown factor in prolonged missions appears to be the potential effects of confinement and weightlessness on the cardiovascular and musculoskeletal systems. A.C.R.

N69-36796# School of Aerospace Medicine, Brooks AFB, Tex. Environmental Physiology Div.

NUTRITION FOR LONG SPACE VOYAGES

John E. Vanderveen *In its* Bioastronaut. and the Exploration of Space Nov. 1968 p 421-430 refs (See N69-36776 21-04)

Avail: CFSTI

Nutrient deficiencies and actual tissue losses evidenced from the Mercury and Gemini flights demonstrated the need for careful planning of the space crew's diet on an individual basis. Individual planning is necessary because nutrient requirements vary from person to person, although methods of establishing these needs are difficult to establish. Greater attention must also be placed on vitamin and trace element requirements of astronauts, a factor which at the present time is ill-defined. The importance of food acceptance in long space voyages is also considered, due to its effect on total consumption. Finally, storage problems are treated for missions up to 120 days, for which dehydrated foods similar in composition to those used in the Apollo program can be used, as well as those associated with longer flights. It is anticipated that chemical and bioregeneration systems will probably have greater efficiency than carry-aboard foods for the latter missions. A.C.R.

N69-36799# School of Aerospace Medicine, Brooks AFB, Tex.

PLANETARY ENVIRONMENTAL MEDICINE (MARS)

Hubertus Strughold *In its* Bioastronaut. and the Exploration of Space Nov. 1968 p 493-509 refs (See N69-36776 21-04)

Avail: CFSTI

The medical aspects of interplanetary flight and man's ecological-physiological requirements are discussed as related to the likelihood of mission success. Emphasis is placed on the specific problems encountered on a flight to Mars, considered as probably the only visitable planet. It is concluded that a manned landing mission to Mars, from a medical point of view, is feasible if the flight is based on a fast transfer trajectory. The experience gained in a lunar laboratory prior to undertaking such a flight will be of great benefit; establishment of such a station is also feasible within this century. A.C.R.

N69-36802# Academy of Sciences (USSR), Moscow.

PROBLEMS IN DETECTION OF EXTRATERRESTRIAL LIFE

A. A. Imshenetsky *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 553-568 refs (See N69-36776 21-04)

Avail: CFSTI

A reliable method for detection of extraterrestrial life is presented, based on recording of growth and multiplication of heterotrophic microorganisms which might occur on planetary surfaces. Microbe existence is probable in two cases: (1) Various organic substances are accumulated on a planet as a result of chemical evolution (abiogenic synthesis); (2) Chemosynthetic or photosynthetic bacteria are present which synthesize organic compounds at the expense of atmospheric carbon dioxide. The latter assumption appears more probable. To test its validity, a modification of methods for detection of heterotrophic unicellular organisms is required. It is concluded that two possibilities may arise in searching for extraterrestrial life: (1) Active life may be absent, but, upon chemical and morphological examinations, remnants of former life may be found; the research program should therefore include paleobotanical and paleozoological studies. (2) Microorganisms, which are complex beings in an evolutionary sense, may not be found, but very primitive forms of life might be detected. There is no method at present, however, for conducting such an investigation. A.C.R.

N69-36845*# National Aeronautics and Space Administration, Washington, D.C.

INVESTIGATIONS INTO THE EFFECTS OF CARBONATED WATER CONTAINING SODIUM CHLORIDE UPON THE STRESSES AFFECTING THE BODY WHEN WORKING UNDER WARM CONDITIONS [CERCETARI REFERITOARE LA ACTIUNEA APEI CARBOGAZOASE CLORURO-SODICE ASUPRA SOLICITARII ORGANISMULUI IN MUNCA LA CALD]

Iancu Gontea et al Sep. 1969 22 p refs Transl. into ENGLISH from Probl. Terap. (Bucharest), v. 2, 1955 p 133-153 (NASA-TT-F-12321) Avail: CFSTI CSCL 06S

A comparative study of the effects upon the bodies of the same persons under identical work conditions and high temperatures (31-35°C), where on one day the water regimen was tap water and on the other day was carbonated salted water containing 2.5 g NaCl per liter is reported. Author

N69-36870# Louisville Univ., Ky. Dept. of Opthalmology.

STUDY OF OCULAR EFFECTS OF CHRONIC EXPOSURE TO LASER RADIATION

Theodore Lawwill, Eugene P. Reese, Frank H. Sharp, and William E. Cox 1 Feb. 1969 28 p refs

(Contract DADA17-68-C-8105)

(AD-688181; Rept-1) Avail: CFSTI CSCL 6/5

Development of a model was initiated to compare retinal damage caused by chronic exposure to c.w. laser radiation and that caused by conventional illumination. The purpose of the comparison is to establish safety standards for c.w. lasers. The experimental animal used so far has been the rabbit. It was discovered that the rabbit eye is much more resistant to this kind of damage than animals previously tested. Author (TAB)

N69-36895*# Techtran Corp., Glen Burnie, Md.

A NEW CASE OF DIABETES INSIPIDUS WITH POLYDIPSIA. STUDY OF THIRST [UNE NOUVELLA OBSERVATION DE DIABETE INSIPIDE A PRECESSION POLYDIASIQUE. ETUDE DE LA SOIF]

M. Raoul, Simonne Kouritsky, Jacques Sicard, and Jean-Jacques Galey Washington NASA Sep. 1969 9 p refs Transl. into ENGLISH from Bull. Mem. Soc. Med. Hop. Paris, v. 58, 1942 p 115-121

(Contract NASw-1685)

Avail: CFSTI CSCL 06P

A considerable diabetes insipidus (18 l/day) developed in a 22-year-old girl, reacting perfectly to hypo-physial extract, plus an adepose-genital syndrome and a weight gain of 26 kg in one after a cranial traumatism. The role of thirst is examined. Author

N69-37031*# National Aeronautics and Space Administration, Washington, D.C.
THE INFLUENCE OF GRAVITY ON THE DEVELOPMENT AND THE MAINTENANCE OF BILATERAL SYMMETRY IN THE FROG EGG [UEBER DEN EINFLUSS DER SCHWERKRAFT AUF DIE ENTSTEHUNG UND ERHALTUNG DER BILATERALEN SYMMETRIE DES FROSCHEIES]
M. Moszkowski Sep. 1969 40 p refs Transl. into ENGLISH from Arch. Microskopische Anat. und Entwicklungsgeschichte (Freiburg), v. 60, 1902 p 17-65
(NASA-TT-F-12514) Avail: CFSTI CSCL 06C

Two extreme views regarding the influence of gravity on the organic formation of the developing egg are critically reviewed. The first view holds that gravity affecting the egg in the direction of its axis is absolutely required for the development of normal embryos. The second view holds the development of the egg to be the product of the most autonomous autodifferentiation and denies that the force of gravity as well as any other external force exerts a formative influence on the development of the frog egg. Based on the review of applicable literature and on experimental evidence obtained in the course of this study, it is shown that gravity has a direct, regulative effect on the development of the symmetrical structure of bilaterally symmetrical organisms and possibly also on the development of radially symmetrical organisms. K.W.

N69-37062*# Princeton Univ., N.J.
SECOND-ORDER WAVE STRUCTURE IN SUPERSONIC FLOWS
David A. Caughey Washington NASA Sep. 1969 87 p refs
(Grant NGR-31-001-119)
(NASA-CR-1438) Avail: CFSTI CSCL 20D

Second-order effects upon the wave systems associated with bodies in uniform supersonic flight are considered. An appropriate scaling of the independent variables is introduced to take into account the locally small, but cumulative, nonlinearities which determine the validity of the classical perturbation theories at large distances from the body. Predicted shock angles for the flow over slender wedges (planar flow) and cones (Axisymmetric flow) are compared with exact inviscid calculations to show the improvement afforded by inclusion of second-order effects. Inclusion of the full second-order solution is required to achieve appreciable improvement over the first-order theory for the conical case. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N69-36186*# Research Triangle Inst., Durham, N.C. Engineering and Environmental Sciences Div.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN AIR POLLUTION CONTROL Final Report, 15 Jun. 1968 - 14 Jun. 1969
19 Jun. 1969 65 p refs
(Contract NSR-34-004-056)
(NASA-CR-105548; RTI-EU-411-3) Avail: CFSTI CSCL 13B

The results of activities in the area of air pollution control are presented. This work is part of a feasibility program to determine the effectiveness of methods for transferring aerospace generated technology to non-aerospace problems and requirements. Forty-one specific technology related problems and requirements existing in programs of the National Air Pollution Control Administration were identified. Problem abstracts were prepared on 21 of these problems and computer information searches were completed. The problems and requirements which were investigated involve meteorological instrumentation, the effects of gaseous and particulate pollutants, detection instrumentation for both gaseous and particulate pollutants, process control for the elimination of pollutants, and chemical and thermal properties of pollutants. Author

N69-36271*# AiResearch Mfg. Co., Los Angeles, Calif. Dept. of Life Sciences.
MAN'S CAPABILITY FOR SELF-LOCOMOTION ON THE MOON. VOLUME 2: SUMMARY REPORT
E. C. Wortz, W. G. Robertson, L. E. Browne, and W. G. Sanborn Washington NASA Sep. 1969 85 p refs Revised
(Contract NAS1-7053)
(NASA-CR-1043; Rept-68-4262-Vol-2-Rev-1) Avail: CFSTI CSCL 06S

A comprehensive study of man's self-locomotive capabilities in simulated lunar gravity is presented. An inclined-plane and a gimbal-vertical simulator equipped with treadmills were used to simulate lunar gravity. Man's locomotive characteristics and the metabolic costs of walking, running, and loping at velocities from 2 to 12.8 km/hr were determined for subjects in pressurized Gemini-4C suits. The results showed that the energy cost of locomotion in simulated lunar gravity is considerably less than that in earth gravity. Ascending grades caused large increases in metabolic cost over that of level walking where the magnitude of the cost depends on the simulation technique used. Increasing the load carried from 75 to 400 earth pounds had a small and inconsistent effect on metabolic costs. Changing the smooth, hard walking surface to sandy soil caused a large increase in the metabolic cost at the higher locomotion rates. Author

N69-36419# Human Engineering Labs., Aberdeen Proving Ground, Md.
RADAR SYMBOLOGY STUDIES LEADING TO STANDARDIZATION: PART 2: DISCRIMINATION IN MIXED DISPLAYS
Jane C. Davis Mar. 1969 86 p refs
(AD-688125; HEL-TM-5-69) Avail: CFSTI CSCL 5/8

The report covers continued studies toward standardization coding symbols for an information display. Experiments were directed toward locating the most readily discriminated five-symbol code complex as measured by errors and location times. Experiment 1 attempted to simplify testing procedures by using a card sorting task. The same five-symbol code was presented as a black-on-white simulated display in Experiment 2. Results were not comparable and the simulated display was used in further experiments with a variety of codes. Legibility and association values of individual forms varied with the population of shapes within the code complex. Experimental results led to general recommendation for code design. Author (TAB

N69-36709*# Environmental Research Associates, Randallstown, Md.
STUDY OF THE ASTRONAUT'S CAPABILITIES TO MAINTAIN LIFE SUPPORT SYSTEMS AND CABIN HABITABILITY IN WEIGHTLESS CONDITIONS
Harry L. Loats, Jr., George M. Hay, and Edwin Morris Washington NASA Aug. 1969
(Contract NAS1-7887)
(NASA-CR-1405; ERA-68-1) Avail: CFSTI CSCL 06S

The main emphasis during the program was to determine the applicability of various restraint and locomotion aids related to the performance of a variety of critical intravehicular tasks. Although the exact nature of future space station missions and hardware is not fully defined at present, certain important characteristics are indicated. Specific characteristics of the tasks were investigated and included: maintenance and repair of life support systems; working at a work bench, a standup platform, a work station, and a control console; locomotion about the interior of the compartment, data collection tasks including writing and calculations, cargo handling and storage, and general and housekeeping tasks. Author

N69-36798# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Biodynamics and Bionics Div.

BIONICS: ITS ROLE AND FUTURE IN SUPPORT OF ASTRONAUTICS

Henning E. von Gierke *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 461-492 refs (See N69-36716 21-04)

Avail: CFSTI

A review of the status of bionics/biocybernetics research and its potential contributions to astronautics is presented. It is suggested that human recognition capability and control can be replaced step-by-step by machine recognition devices and self-adaptive computers. The applied physical sciences will be penetrated more and more deeply with biological concepts, ideas and capabilities. The biological roots of the functional capabilities and of the expressions used to describe them will be forgotten with the use of automatic learning systems. It is thus concluded that biological research today no longer serves exclusively the direct support of man, but has potential impact on nearly every area of modern technology. The challenge of the self-contained microworld of space requires close coupling between man and the machines built to assist him and between the biomedical and physical-engineering disciplines. A.C.R.

N69-36842# Beckman Instruments, Inc., Fullerton, Calif. Advanced Technology Operations.

PARAMAGNETIC OXYGEN SENSOR STUDY Final Technical Report, 1 May 1967 - 1 Jun. 1968

Malbone W. Greene Wright-Patterson AFB, Ohio AMRL Jan. 1969 44 p

(Contract F33615-67-C-1632)

(AD-688260; FR-2488-101; AMRL-TR-68-123) Avail: CFSTI CSCL 6/11

A 4-month theoretical study of the Pauling Paramagnetic Oxygen Sensor was conducted. The results were condensed into a design criteria report that proposed a specific tentative design for a breadboard aerospace paramagnetic oxygen sensor. The selected approach utilized a capacitance bridge position sensing technique combined with electrostatic null-balancing to provide an electrical output that is a stable and linear function of the sample partial pressure of oxygen. Finally, the breadboard sensor was fabricated and tested for compliance to theoretical predictions and to specific design goals. The breadboard paramagnetic sensor fully meets the three basic contract requirements. Specifically, it uses the paramagnetic principle; it is applicable to manned space vehicle operation surviving typical launch and reentry environments. The mechaniams of the technique are well understood. In addition, the sensor meets or exceeds all specific design goals except its weight of 5.7 pounds (5 pounds desired) and an extraneous thermal coefficient due to mechanical distortion of critical parts with thermal variations that was observed in the first test unit. However, a flight unit can be reduced in weight to less than 5 pounds, and it has been demonstrated that standard mechanical design approaches will eliminate the extraneous thermal effects. Author (TAB)

N69-36825*# Dunlap and Associates, Inc., Darien, Conn.

DIFFERENTIAL THRESHOLDS FOR MOTIONS IN THE PERIPHERY

James M. Link and Leroy L. Valleria Washington NASA Sep. 1969 22 p refs

(Contract NAS12-88)

(NASA-CR-1439; BSD-69-701) Avail: CFSTI CSCL 06N

A study was conducted to determine the differential thresholds for rotary and linear motion in the periphery. Isograms were developed based on threshold estimates obtained from ten subjects using the psychophysical method of limits. The results of this study indicated that differential thresholds for rotary and linear motion were found to increase as a linear function of eccentricity angle. Threshold isograms for both types of motion are elliptical in shape with the horizontal axis approximately twice as long as the vertical axis. Based on statistical analysis, there appears to be no real difference between rotary and linear motion. Subjects, however, reported a preference for rotary motion. Thresholds decreased logarithmically as a function of changing speed. Age of the subject appears to be a highly significant factor which influences the perception of motion. At high display velocities, subjects reported the occurrence of interference factors such as blur, fusion, strobing and flicker. These factors were particularly noticeable with the linear display. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N69-36021 Princeton Univ., N.J.

COBALT (II), NICKEL (II), AND COPPER (II) COMPLEXES OF N-SUBSTITUTED ANTHRANILIC ACIDS AND PROTON MAGNETIC RESONANCE STUDIES OF PARAMAGNETIC SYSTEMS

James Robert Hutchison (Ph.D. Thesis) 1968 109 p

Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-2544

The nickel(II), cobalt(II), and copper (II) complexes of anthranilic acid and the nickel(II) and cobalt(II) complexes of N-methylanthranilic acid are polymeric octahedral complexes where the ligand functions as a chelating agent coordinating through the nitrogen group and the carboxyl oxygens. Bis(N-methylanthranilato)copper(II) and all complexes containing a nitrogen substituent of an ethyl or larger group did not coordinate through the nitrogen. These complexes also form polymeric octahedral species which in some cases contain coordinated water. The synthesis, properties, and PMR spectra are reported for the new complex dichlorobis [N-methyl-α-(2-pyridyl)nitrone] nickel(II) and its methyl derivatives. The pyridyl nitrone ligands function as bidentate chelating agents. The two remaining coordinating positions in the six-coordinate complexes are filled by the chloride ions in the solid state and by water molecules in aqueous solutions of the complexes. Isotropic PMR shifts for protons of water in aqueous solutions of cobalt(II) containing a variety of monodentate ligands, were measured. The results indicate that the magnitude of the shift in the bulk water resonance does not invariably decrease as water is displaced from the primary coordination sphere. A marked increase in the shift upon complexation was observed for the system cobalt(II)-thiocyanate which was studied in detail. The non-Curie temperature dependence of the proton isotropic shifts of aqueous copper(II) and nickel(II) solutions is confirmed over the temperature range 0° - 160° Dissert. Abstr.

N69-36053 Purdue Univ., Lafayette, Ind.
THE CHEMISTRY OF SOME GROUP VI-SILICON COMPOUNDS
Edwin John Louis, Jr. (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-2950

A study of some group six silicon compounds was made. Dimethylsulfoxide was found to react with hexamethyldisilthiane to produce sulfur, dimethylsulfide, and hexamethyldisiloxane as the main products. However, these produces are accompanied by a red free radical which forms first and has a five line EPR spectrum and a green radical which forms upon aging or heating the solution and had a nine line EPR spectrum. Reactions of halosilanes with barium trithiocarbonate, $BaCS_3$, in various ether solvents were found to give hexamethyl-disilthiane and carbon disulfide as products. Bis (trimethylsilyl) mercury was found to react with 9-fluorenone in hydrocarbon solvents to give a product 9,9' bis trimethylsiloxybifluorene. This material resembles pinacol in structure. Hexamethyldisilthiane reacts with p-toluene sulfonyl azide or chloramine T to give a white needle like crystalline precipitate of S,S-bis (trimethylsilyl) N-p-toluence sulfonyl sulfinimine. This is the first example of a four-coordinated silylsulfide. The sulfinimine reacts with HCl to give trimethylchlorosilane, p-toluene sulfonamide, and sulfur as products. Dissert. Abstr.

N69-36059 Princeton Univ., N.J.
THE DETECTION OF BORON HYDRIDE AND THE OBSERVATION OF THE VIBRATIONAL SPECTRA OF SEVERAL TRANSITION-METAL DIHALIDES
Stephen Harry Garnett (Ph.D. Thesis) 1968 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-2539

Matrix-isolated BH_3CO was photolyzed in an attempt to detect BH_3. Several absorptions were observed, and one at 1134.2 cm^{-1} was assigned to ν_4 of BH_3. An absorption at 900 cm^{-1} is shown to arise from a light molecule containing one boron and at least one hydrogen atom. HBCO is suggested as the source of this band. Another attempt to obtain the infrared spectrum of matrix-isolated BH_3, by pyrolysis of B_2H_6 and BH_3CO, was unsuccessful. When the system was completely dry, no new absorptions were observed. The only absorptions detected resulted from the reaction of the parent molecule with traces of water in the system, although it was possible to observe these bands when no water was detected in the spectrum. These absorptions occurred in the 1350 to 1420 cm^{-1} region and could not be assigned to any previously reported boron-oxygen-hydrogen compound. It is suggested that the absorptions are due to the boron-oxygen stretching vibrations of $H_2B-O-BH_2$ and H_2BOH. The asymmetric stretching absorptions of matrix-isolated $MnCl_2$, MnF_2, $NiCl_2$ and NiF_2 were observed. No absorptions attributable to the symmetric stretching or bending vibrations of these molecules were detected. Dissert. Abstr.

N69-36074*# Schwarzkopf Microanalytical Lab., Woodside, N.Y.
DETERMINATION OF THE DENSITY AND CHEMICAL PROFILES OF GOVERNMENT-FURNISHED CHARRED ELASTOMERIC ABLATOR MODELS
Dec 1968 48 p
(Contract NAS1-8212)
(NASA-CR-66816) Avail: CFSTI CSCL 07B

Ablation materials were analyzed to determine the total amounts of carbon, hydrogen, silicon and silicon carbide, residue, free oxygen, free carbon, and density of the samples. The analytical methods used are described, and the content percentages of these elements for each model are tabulated. F.O.S.

N69-36078# Bristol Univ. (England).
NEW REACTIONS OF METAL CARBONYLS AND RELATED COMPOUNDS Final Technical Report, Jul. 1967 - Jun. 1968
F. G. A. Stone Aug. 1968 64 p refs
(Contract DAJA37-67-C-0622)
(AD-677409) Avail: CFSTI CSCL 7/2

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N69-36077# Bristol Univ. (England). Dept. of Inorganic Chemistry.
SPECTROSCOPIC STUDIES ON ORGANOMETALLIC COMPOUNDS. PART 17: INFRARED SPECTRA OF DICARBONYL(PI-CYCLOPENTADIENYL)IRON COMPLEXES IN THE CARBONYL STRETCHING REGIONS
J. Dalton, I. Paul, and F. G. A. Stone *In its* New Reactions of Metal Carbonyls and Related Compds. Aug. 1968 p 1-34 refs (See N69-36076 21-06)
Avail: CFSTI

The infrared spectra of a series of complexes $(\pi-C_5H_5)Fe(CO)_2X$ (X = halogen, $SiCl_3$, $GeCl_3$, $SnCl_3$, $SnPh_3$ and $SnMe_3$) and that of the related complex $(\pi-C_5H_5)Co(CO)_2$ were examined in the fundamental, binary, and ternary carbonyl stretching regions. The results for the tin-iron complexes are interpreted in terms of π-bonding increasing in importance along the ligand series $SnMe_3$, $SnPh_3$ and $SnCl_3$. For the halogen complexes π-bonding between iron and the halides is considered to be negligible. A tentative interpretation of the relative intensities of the binary combination bands is presented. Author

N69-36078# Bristol Univ. (England). Dept. of Inorganic Chemistry.
CHEMISTRY OF THE METAL CARBONYLS. PART 51: ORGANOTIN-(CARBONYL)RUTHENIUM COMPLEXES
J. D. Cotton, S. A. R. Knox, and F. G. A. Stone *In its* New Reactions of Metal Carbonyls and Related Compds. Aug. 1968 p 35-54 refs Submitted for publ. (See N69-36078 21-06)
Avail: CFSTI

The preparation of tin-ruthenium bonded complexes $(R_3Sn)_2Ru(CO)_4$ is studied. These complexes are prepared by reacting triorganotin hydrides with dodecacarbonyl triruthenium, when additional products of molecular formula $R_{10}Sn_4Ru_2(CO)_8$ are produced. Both $(Me_3Sn)_2Ru(CO)_4$ and $Me_{10}Sn_4Ru_2(CO)_8$ are formed in low yields by heating dimethylstannane or hexamethylditin with dodecacarbonyl triruthenium. The course of these reactions is somewhat different from those observed previously with iron carbonyls. Further differences in the two systems are revealed by the existence of *cis* and *trans* isomers of $(R_3Sn)_2Ru(CO)_4$ compared with the uniform *cis* symmetry of the known iron analogues. The infrared spectra of the new compounds in the carbonyl stretching region are reported, and some aspects of their mass spectra discussed. Author

N69-36079# Bristol Univ. (England).
ORGANOSILICON(CARBONYL)RUTHENIUM COMPLEXES
S. A. R. Knox and F. G. A. Stone *In its* New Reactions of Metal Carbonyls and Related Compds. Aug. 1968 p 55–57 refs
(See N69-36076 21-06)
Avail: CFSTI

The synthesis and characterization of the new organosilicon(carbonyl)ruthenium compounds are described. The reaction between organo-silanes and ruthenium carbonyl is examined. In this manner a series of complexes were obtained containing silicon-ruthenium bonds. Author

N69-36084# Air Force Office of Scientific Research, Arlington, Va. Directorate of Chemical Sciences.
FOURTEENTH ANNUAL CHEMISTRY PROGRAM REVIEW (Special Scientific Report, Fiscal Year 1968)
William L. Ruigh and Donald L. Ball Jan. 1969 174 p refs
(AD-688878; AFOSR-69-2810) Avail: CFSTI CSCL 7/2

The review provides a record of research in progress together with illustrative achievements resulting from the basic research program of the Directorate of Chemical Sciences, AFOSR (OAR). There are three main sections in the review. The first section is devoted to research high lights under the headings of Chemical Instrumentation and Techniques, Chemical Structure and Properties, Chemical Energetics, Theoretical Chemistry, and Chemical Synthesis and Dynamics. The second section contains summaries of program statistics. The third section consists of factual summaries of each project completed during fiscal year 1968. Author (TAB)

N69-36096 Southern Illinois Univ., Carbondale.
THE KINETICS OF THE PYRIDINE-CATALYZED HYDROLYSIS OF CHLOROPENTAPHENYL-CYCLOTRIPHOSPHONITRILE
Vernon R. Miller, Jr. (Ph.D. Thesis) 1968 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-1757

The chemical kinetic data do not conform to any simple rate law. Since the reaction is retarded by chloride ion, and the presence of a pyridinium-phosphonitrile intermediate was indicated by a competition study between water and fluoride ion, a nucleophilic base-catalysis mechanism was proposed. Isolation and characterization of the compound gave further evidence in support of nucleophilic base catalysis involving a stable pyridinium-phosphonitrile intermediate. A much slower uncatalyzed or solvent catalyzed hydrolysis path was also shown to be present. Due to the complexity of the system only approximate values for the specific rate constants were obtained. Dissert. Abstr.

N69-36099 Michigan Univ., Ann Arbor.
THE CRYSTAL AND MOLECULAR STRUCTURES OF A BENZYNE ADDUCT, DIBENZO TETRACYCLO DECA-2, 7 DIENE, AND AN AZIDOTRIAZOLE DECOMPOSITION PRODUCT, 1-P-TOLYL 3 (ALPHA CYANO) BENZYLIDENE TRIZENE, BY COMPUTER IMPLEMENTED PATTERSON SEARCHING
Jesse William Schilling (Ph.D. Thesis) 1968 78 p
Avail: Univ. Microfilms: HC $16.20/Microfilm $4.50 Order No. 69-2384

Crystal structures of two light-atom organic molecules determined by the vector search method of Patterson function interpretation are treated. It is proposed that Patterson searches may be meaningfully interpreted in terms of ideal Gaussian Patterson peaks, as they would be represented by a Fourier synthesis whose terms are truncated, as are the observed reflection data. The sampling frequency of an ideal peak by a single vector is introduced as a simple way of comparing different searches. A unique application of the integrating oscillation method of X-ray data collection is described. This involves setting an orthorhombic crystal about a face diagonal and performing a single 90° oscillation sweep with a continuously varying inclination angle. Numerous computing algorithms, not all specifically crystallographic, are presented in flowchart form including: (1) determination of overall anisotropic thermal parameters by a modified method; (2) relative scaling of experimental data when the scale is a function of two independent attributes of the data; (3) vector-space refinement of a partial crystal structure; (4) vector-space model testing; (5) determination of *a priori* general multiplicities for search vectors due to the mutual overlap of the corresponding ideal Patterson peaks; and (6) modifications to a binary sorting algorithm for scientific data of limited accuracy. Dissert. Abstr.

N69-36125 Brandeis Univ., Waltham, Mass.
NUCLEAR MAGNETIC RESONANCE IN FERROUS FLUORIDE BELOW THE NEEL TEMPERATURE
Stanley M. Kulps (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-2056

A study of the antiferromagnetic material, ferrous fluoride (Neel temperature, T_N = 78.37°K) is reported using the techniques of nuclear magnetic resonance (NMR). The frequencies of the NMR lines due to the F^{19} nuclei were measured in zero external field, as a function of temperature, over the range 4.2°K–78.330°K. Analysis of the data yielded the temperature dependence of the sublattice magnetization, and it was found that the formulated power law accurately describes the data within the temperature span, $.9736 \leq T/T_N \leq .9996$. Line width measurements indicated a rapid broadening of the NMR line as the Neel point is approached. Dissert. Abstr.

N69-36130 Princeton Univ., N.J.
ENERGY REQUIREMENTS FOR BIMOLECULAR REACTION: HI PLUS DI
Stephen Bruce Jaffe (Ph.D. Thesis) 1968 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-2746

Results of experiments to measure reaction cross sections for the formation of deuterium hydride as a consequence of energetic collisions between hydrogen iodide and deuterium iodide are reported. Through a reaction chamber containing a low density background of deuterium iodide, a molecular beam of hydrogen iodide accelerated up to energies of 200 kcal/mole was passed. A quadrupole mass spectrometer monitoring the gases effusing from the chamber was used to detect the reaction product deuterium hydride. In the range of collision energies investigated, up to 2.9 times the experimental activation energy of 44 kcal/mole, no reaction product was detected to the limit of sensitivity of the equipment. From this an upper bound to the reaction cross section was determined to be less than 0.05 $Å^2$ over the range. Since the experimental system provides collisions between molecules in relatively low internal energy states, it was concluded that translational energy is not sufficient to cause appreciable reaction between hydrogen iodide and deuterium iodide. Further, the energy requirements for chemical reaction may be specific in their vibrational or rotational excitation of the reactants may be necessary to activate for chemical reaction. Dissert. Abstr.

N69-36131 Washington Univ., St. Louis, Mo.
RETENTION TIME AND BAND BROADENING IN PROGRAMMED TEMPERATURE AND PROGRAMMED PRESSURE GAS CHROMATOGRAPHY
David George Hartzog (Ph.D. Thesis) 1968 277 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.00 Order No. 69-2439

Theoretical models describing the retention time and peak width of eluted components in an analytical-scale gas chromatographic column under the following modes of programmed operation are presented: (1) linear temperature programming (LTP); (2) linear reciprocal temperature programming (LRTP); (3) exponential pressure programming (EPP); (4) simultaneous EPP and LTP; and (5) simultaneous EPP and LRTP. Since the solutions of all these cases required numerical integration, a FORTRAN IV master program was written to perform the calculations. The solutions obtained for the programmed temperature cases are compared to the analytical solutions of previously proposed approximate models of such operations. Experimental data were obtained for both types of temperature programming for six hydrocarbons which were in excellent agreement with those predicted from theory. In control instrumentation applications of gas chromatography, temperature programming may serve to reduce the analysis time.
Dissert. Abstr.

N69-36141 Vanderbilt Univ., Nashville, Tenn.
THE INVERSION TRANSITION IN FORMALDEHYDE. PART 2: VIBRONIC INTERACTION: A SECOND ORDER TREATMENT. PART 3: MOLECULAR INTEGRALS BY THE GAUSSIAN TRANSFORM METHOD
Venketrama Sethuraman (Ph.D. Thesis) 1968 250 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.25 Order No. 68-17994

A first-order perturbation result for centrifugal distortion in a vib-rotor with rotation-coupled vibrations is derived, though its practical usefulness had not yet been assessed. The Hamiltonian kinetic energy for an XYXZ pyramid that undergoes inversion is set up, and the procedure for determination of the inversion-vibration interaction parameters from the observed vibrational levels is discussed. Also included is a vibrational analysis of the $^1A'' - {}^1A_1$ spectrum at 300°K and at 400°K of the formaldehyde molecules HCHO, HCDO, and DCDO. Interaction of vibrations through rotation about the principal axes of the molecule, and anharmonic resonance interactions are found to explain satisfactorily almost all the rotational level perturbations observed in the vibronic states of these molecules. The vibronic Hamiltonian is expanded in the nuclear coordinated to terms up to second order. The Gaussian transform method of calculating molecular integrals over exponential orbitals is also discussed.
Dissert. Abstr.

N69-36148 Princeton Univ., N.J.
SCOPE AND LIMITATIONS OF A FUNCTION RELATING TEMPERATURE, TEMPERATURE DEPENDENT PHYSICAL PROPERTIES AND THE THERMODYNAMIC PARAMETERS DERIVED THEREFROM: THE 9-DIMETHYLAMINO-9, 10-DIHYDRO-4, 5-DIMETHYLPHENANTHRENE SYSTEM
Richard Gans (Ph.D. Thesis) 1968 267 p
Avail: Univ. Microfilms: HC $12.15/Microfilm $3.45 Order No. 69-2538

The scope and limitations of a computational method for obtaining thermodynamic parameters and physical properties from temperature dependent data were investigated. It is shown that certain assumptions previously made in the application of this method to conformational analysis can lead to serious errors. Most of the pertinent data were reprocessed by use of various computer programs. A critical analysis is presented of the results obtained. The configuration, thermodynamics, and kinetics of the conformational isomerization of 9-dimethylamino-9, 10-dihydro-4, 5-dimethylphenanthrene were studied. The NMR spectrum of the equilibrated mixture of diastereomers revealed the presence of two superposed ABC patterns corresponding to the methine-methylene fragments. Only one of the diastereomers was available, and its spectrum was subtracted from the spectrum of the mixture. The ABC patterns were analyzed with the aid of a computer program to give the coupling constants in each diastereomer. The temperature dependence of the NMR spectrum of the mixture of diastereomers was used to compute thermodynamic parameters which could be compared with results obtained. The rates of isomerization obtained confirmed rates of mutarotation previously obtained.
Dissert. Abstr.

N69-36147*# Pennsylvania State Univ., University Park. Materials Science Dept.
DYNAMIC ABSORPTION OF CARBON DIOXIDE ON MICROPOROUS CARBONS
O. P. Mahajan, M. Morishita, and P. L. Walker, Jr. [1969] 30 p refs
(Grant NGR-39-009-015)
(NASA-CR-105595) Avail: CFSTI CSCL 07D

The dynamic adsorption of CO_2, at a partial pressure of about 4 Torr (total pressure, 1 atmosphere), was studied on two relatively pure carbon sieves and one commercial active carbon at 25°C. Regeneration of the carbon activity over a number of adsorption–desorption cycles was also studied. The capacity of the carbon for CO_2 and its regeneration depends not only upon the porous nature of the carbon but also on the amount and type of the impurities present on the carbon surface. The results show that a substantial proportion of CO_2 adsorbed on the active carbon is held on impurities, the carbon with its large surface area acting as a support for these impurities.
Author

N69-36149 Maryland Univ., College Park.
EVIDENCE FOR THE 3 DELTA SUB u YIELDS B SUP 3 Hg TRANSITION IN N SUB 2
Hsiu-Li Wu (Ph.D. Thesis) 1968 68 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-2236

A dc discharge through 2 to 10 torr of flowing nitrogen gas was observed with an infrared spectrometer. Eleven molecular bands were recorded of which the 4435, 4134, 3830, 3514, 2998, 2730 and 2457 cm^{-1} bands were assigned to the given system in accordance with the vibrational analysis. The resolution of the spectra in this experiment was not great enough to permit a detailed rotational analysis. However, from the deduced electronic and vibrational constants of the $^3\Delta_u$ state and the known molecular constants, a theoretical determination can be made of the positions and intensities of the rotational lines of bands in the system by treating the rotational and the coupling constants of the $^3\Delta_u$ state as parameters. Such a treatment involves 27 branches per band without taking Λ-doubling into account. The goal of the calculation is to reproduce the low resolution features of a band, where individual rotational details are badly overlapped but which contains a great deal more information than would a simple contour display.
Dissert. Abstr.

N69-36150 Purdue Univ., Lafayette, Ind.
CALORIMETRY AND THERMODYNAMICS OF AQUEOUS ELECTROLYTES AT HIGH TEMPERATURES
William Lee Gardner (Ph.D. Thesis) 1968 240 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 69-2921

A high pressure, twin, solution calorimeter which utilized thermistors as temperature sensing elements was used to make heat of solution measurements of NaCl in water from 100° to 200°C. The heats of solution, extrapolated to infinite dilution, were −1726, −3096, and −5870 cal. $mole^{-1}$ at 114.25°, 149.90°, and 199.50°C respectively. From these values standard partial molal heat capacities and entropies were calculated for aqueous sodium chloride. The partial molal entropy of NaCl(aq) was 24.3, 21.2, and 18.4 cal. $mole^{-1}$ $deg.^{-1}$ at 100°, 150°, and 200°C respectively. A submarine-type solution calorimeter was also used to measure the heats of solution of Na_2SO_4 from 0°–100°C

From the experimental data obtained for Na_2SO_4(aq), the partial molal heat capacity of H_2SO_4(aq) was calculated from the known difference of the heat capacity of Na^+ and H^+ over this temperature range. The heat capacities of H_2SO_4(aq) were used to analyze certain sulfate ion cell potentials. From this third law analysis, a new and more consistent set of mean activity coefficients of H_2SO_4(aq) was generated from 0–55°C. Finally, a new design was proposed for aqueous heat of solution calorimeters operating above 100°C. Dissert. Abstr.

N69-36183 Maryland Univ., College Park.
ULTRASONIC STUDY OF TERTIARY BUTYL ALCOHOL IN CYCLOHEXANE
Frank Herbert Garland (Ph.D. Thesis) 1968 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-2509

The ultrasonic absorption technique was used to study the self-association of t-butyl alcohol in cyclohexane at 5°C, 10°C, and 15°C. The absorption data were interpreted in terms of a single relaxation, and characteristic time constants of the association process were found. It was concluded from the variation of the time constants with concentration of alcohol that the relaxation is due to perturbation of a monomer-dimer equilibrium. The method used to calculate the time constants from the absorption data is discussed. Dissert. Abstr.

N69-36184 Clark Univ., Worcester, Mass.
THERMODYNAMICS OF HYDROCARBON GASES IN AQUEOUS TETRAALKYLAMMONIUM SALT SOLUTIONS
John Hui-hsiung Hung (Ph.D. Thesis) 1968 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-17230

Solubilities of methane, ethane, and propane in water and in aqueous solutions of 0.1 to 1 molal R_4NBr were measured at 5°, 15°, 25° and 35°. Measurements were carried out under constant total pressure and constant temperature yielding solubilities with precision of ± 0.3% or better. These hydrocarbons were salted in by Et_4NBr, Pr_4NBr and Bu_4NBr, but were salted out by NH_4Br. They were either salted in or out by Me_4NBr and $(EtOH)_4NBr$ depending upon the hydrocarbon size and temperature. The dependence of the gas solubility on the salt concentration was linear for NH_4Br and $(EtOH)_4NBr$ but was curved for large R_4NBr salts particularly at lower temperatures. The data seem to indicate that the salting-in may be attributed to two factors: the increase in the number of cavities available for hydrocarbon molecules and the hydrophobic contact between the nonpolar groups of these cations and hydrocarbons. Dissert. Abstr.

N69-36193*# Peninsular ChemResearch, Inc., Gainesville, Fla.
DEVELOPMENT OF VULCANIZABLE ELASTOMERS SUITABLE FOR USE IN CONTACT WITH LIQUID OXYGEN
Annual Summary Report, Jun. 1967 – May 1968
Dale A. Warner Sep. 1968 73 p refs
(Contract NAS8-5352)
(NASA-CR-102228; CPB-02-1183-63; ASR-5) Avail: CFSTI CSCL 07C

The homopolymers of $CH_2=CHCO_2CH_2(CF_2CF_2)_nH$, (n = 1, 2, and 3) were prepared and their low temperature tensile properties studied. Increasing values of n were found to bring about increasing elongations and decreasing tensile strength and toughness. Attempts to prepare copolymers with vinylidene fluoride were unsuccessful. Attempts to prepare cyclopolymers of perfluoroglutaraldehyde, perfluoroglutaryl fluoride, and perfluoro-3-oxaheptadiene-1,6 were unsuccessful. Polyanhydrides of fluorocarbon dicarboxylic acids were found to be hydrolytically unstable. Polycondensation of perfluoroaldehyde hydrates with fluorocarbon dicarboxylic acids did not produce the expected linear polyesters. Work was begun on the preparation of esters derived from oligomers of hexafluoropropylene oxide. Author

N69-36208*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THERMODYNAMIC BEHAVIOR OF TRIVALENT GALLIUM, ALUMINUM AND IRON DISTRIBUTIONS IN GARNETS
Robert F. Mueller and Subrata Ghose Aug. 1969 23 p refs
Presented at the 8th Intern. Congr. of Cryst., Stony Brook, N.Y., 15 Aug. 1969 Submitted for publication
(NASA-TM-X-63646; X-644-69-326) Avail: CFSTI CSCL 07D

Data on the distribution of Ga^{3+}, Al^{3+} and Fe^{3+} among the tetrahedral and octahedral sites in certain garnets were examined in terms of a thermodynamic model which yields an expression for the distribution constant K°, based on site occupancy fractions and the equivalents to activity coefficient products. With the presently available precision the calculated temperature sensitivity of K° is such that variations of several hundred degrees in the sintering temperature should be apparent. It is stressed that this form of ideal mixing on the individual sites corresponds to nonideal mixing of the component end members when referred to their mole fractions and mean molar volumes. This is consistent with the apparent positive deviation of the mean molar volume from a straight line. Author

N69-36238 Rensselaer Polytechnic Inst., Troy, N.Y.
ELECTROLYSIS IN MOLTEN CARBONATES
Peter Klaus Lorenz (Ph.D. Thesis) 1968 226 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 69-2468

Electrolysis of the Li_2CO_3-$LiCl$-Li_2CO_3-LiF-Li_2CO_3 and $(Li,Na,K)_2CO_3$ systems were investigated. The specific electrode reactions were either enhanced or depressed by the atmosphere surrounding the test electrode. A detailed examination of electrode reactions occurring in molten carbonates was undertaken. The anodic and cathodic off-gases were found to be a function of the polarization potential and current density. The current-voltage traces gained from the systems, when the atmosphere surrounding the test electrode was CO, indicated the following order of oxide availability existed in these melts: $LiF-Li_2CO_3 > LiCl-Li_2CO_3 > (Li,Na,K)_2CO_3 > Li_2CO_3$. Two O_2 reduction reactions were observed. At low cathodic polarization, O_2 and CO_2 reduced to carbonate and at more negative polarization, O_2 reduced to oxide. The thermal dissociation of the ternary carbonate eutectic to CO_2 and oxide was measured by means of a concentration cell, and the $CO-CO_2$ reduction reactions were observed below 800°C. Experimental reduction potentials are compared and discussed with theoretical reduction potentials calculated from thermodynamic data. Dissert. Abstr.

N69-36241 California Univ., Riverside.
GAS PHASE REACTIONS OF SINGLET AND TRIPLET METHYLENE
Charles Jonathan Mitschele (Ph.D. Thesis) 1968 150 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-2640

The reactions of singlet and triplet methylene, particularly with propane, were studied. The effects on product yields from ketene-propane mixtures of altering the pressure, ketene:propane reactant ratio, and photolysis wavelength were studied, as well as the changes brought about by addition of nitrogen and oxygen. Benzene, acetone, and mercury photo-sensitization of ketene decomposition (in the presence of propane) was investigated to a limited extent. Brief studies were also made of the

diazomethane-propane, ketene-cyclopropane, and ketene-*cis*-butene-2 photolysis systems. Standard high vacuum techniques were employed; analysis was by microsample gas chromatography on a system connected directly to the vacuum line. Singlet methylene, photolytically generated from ketene, inserts into the secondary C-H bond of propane 1.29 ±0.04 times faster than into the primary C-H bond. Triplet methylene abstracts hydrogen from propane to form methyl and propyl radicals; abstraction from the secondary C-H bond is between 11 and 12 times faster than from the primary C-H bond in propane. The addition of large amounts of nitrogen to ketene-propane mixtures brings about the formation of a triplet methylene species which has quite different properties than those of the triplet produced by photolysis of ketene-propane mixtures. Benzene can transfer either singlet or triplet energy to ketene; the singlet and triplet methylene species so formed have the properties of singlet and triplet methylene formed in direct photolysis of ketene. Dissert. Abstr.

N69-36247 California Univ., Los Angeles.
THE PHOTOCHEMISTRY, VIBRATIONAL SPECTROSCOPY, AND MASS SPECTROMETRY OF PLATINUM (II) COMPLEXES
Stephen Howard Mastin (Ph.D. Thesis) 1968 299 p
Avail: Univ. Microfilms: HC $13.50/Microfilm $3.85 Order No. 69-1116

Recent interest in the photochemistry of transition metal complexes led to an investigation of the photochemical behavior of platinum(II) complexes of the type *cis*- and *trans*-PtL_2X_2, where L is a phosphine or amine and X is a halide. The major reaction found was *cis* ⇌ *trans* isomerization. The mechanism of this photochemical rearrangement was investigated by determining the effects of solvent, light intensity, wavelength of exciting light, and ligand on the quantum yield and photochemical steady-state of the reaction. Absorption and emission spectra were also studied, as were the effects of photosensitizers. It is proposed that isomerization is an intramolecular rearrangement, proceeding via a triplet excited state with tetrahedral geometry. This latter triplet state is presumed to be an intermediate on the basis of observed phosphorescent emission and triplet-sensitized isomerization of $Pt(PEt_3)_2Cl_2$. Brief vibrational and mass spectral studies were also carried out, mainly in support of the above photochemical investigation. Mass spectroscopy was used mainly to determine molecular weights of photoproducts. In addition it was found that fragmentation pathways in isomeric platinum(II) phosphine complexes differ, especially at low ionizing voltages. Dissert. Abstr.

N69-36248 Rensselaer Polytechnic Inst., Troy, N.Y.
THE ELECTRICAL CONDUCTANCE AND DENSITY OF MOLTEN ELECTROLYTES
Frederick W. Dampier (Ph.D. Thesis) 1968 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-2455

Recent theories of electrical conductance and density for 175 molten electrolytes were evaluated using critically compiled data. Temperature-dependent equations for specific conductance, density and equivalent conductance were calculated using the method of least squares. The accuracy of the results was estimated after a careful consideration of the departures between investigators, the experimental techniques and previous results from the respective laboratories. Correlations of the activation energies for electrical conductance and viscosity with the ionic radii were re-examined in light of the critically evaluated data. In both the free volume and zero mobility models, the transport properties of molten electrolytes are interpreted in terms of T_g, the glass transition temperature. The second phase involved the determination of density for $HgCl_2-TlNO_3$ mixtures. This system may be viewed as a high-temperature analogue of the more conventional aqueous solutions since $HgCl_2$ is a molecular compound, while $TlNO_3$ is an ionic compound. The densities were determined using a sealed dilatometric apparatus. The variation of the molar volume with composition shows a large negative deviation from ideality. The apparent molal volume for the $HgCl_2-TlNO_3$ system was found to be a linear function of $C^{1/2}$, as in the case for many concentrated aqueous solutions. Dissert. Abstr.

N69-36342# Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
DETERMINATION OF THE CHAPMAN-JOUGUET PRESSURE AND THE REACTION DURATION IN A SHOCK WAVE OF HIGH POWER EXPLOSIVES
A. N. Dremin et al May 1969 17 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Techn. Fiz. (Moscow), no. 3, 1964 p 139–144
(AD-68247; PA-TT-154) Avail: CFSTI CSCL 19/4

The author describes and discusses an electromagnetic method for measuring the pressure in a Chapman-Jouguet plane and the duration of the chemical reaction in the shock waves of trotyl, hexogen, T.E.N., dynamite, and mixture of trotyl with hexogen. Results are given which indicate that the chemical reaction zone is 5 to 10 times as wide as the earlier spalling method indicated. The experimentally obtained parameters of detonation of TNT and hexogen are in good agreement with independently calculated data. A chemical peak was found in the detonation wave of condensed explosives, confirming the contemporary hydrodynamic theory of detonation. Author (TAB)

N69-36345# Joint Publications Research Service, Washington, D.C.
PHYSICOCHEMICAL MODELING OF INFORMATION AND THOUGHT PROCESSES
N. I. Kobozev 21 Aug. 1968 11 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), May 1968 p 1045–1051
(JPRS-46248) Avail: CFSTI

The extension of computing aggregates or microstates in the Boltzman and Gibbs statistics to negative-entropic systems is analyzed, and the existence of systems which are negative-entropic in nature is described. The criterion is presented of the multiplication of systems of a given type which grow or multiply, i.e. transfer new amounts of matter, energy, and mental effort into the given sort of state. This criterion is called Darwinian, since it applies to system types and not the individual. Equations are given for expressing the properties of stable systems under which the number of systems increases or decreases at a constant rate. F.O.S.

N69-36380*# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
INFARED SPECTRAL STUDIES OF PEROXYACETYL NITRATE (PAN) Final Report, 1 Jan.–31 Dec. 1969
Inge Fild, D. J. Lovell, and John Strong 31 Dec. 1969 21 p refs
(Grant NGR-22-010-042; Contract N00014-67-A-0230-0002)
(NASA-CR-105672; Contrib-50/244) Avail: CFSTI CSCL 07C

Through a photochemical reaction of nitrogen dioxide and 2-trans-butene, peroxyacetyl nitrate (PAN) is formed, which plays an important role in polluted air. The decomposition of this has been studied under two conditions: continued irradiation and in the absence of further irradiation. It was found that the rate of decomposition differed markedly in these two conditions. Different reaction mechaniams are postulated to account for this difference. Author

N69-36413*# Rocketdyne, Canoga Park, Calif. Research Div.
PROPERTIES OF NONAQUEOUS ELECTROLYTES
Rudolf Keller, James N. Foster, Douglas C. Hanson, John F. Hon, and James S. Muirhead Washington NASA Aug. 1969 253 p refs
(Contract NAS3-8521)
(NASA-CR-1425; R-7703) Avail: CFSTI CSCL 07D

Aprotic electrolytes with and without dissolved cupric fluoride and cupric chloride were studied. The electrolytes were based on four solvents: propylene carbonate, dimethyl formamide, acetonitrile, and methyl formate. Characterized components were used to prepare the solutions. Structural studies were performed utilizing nuclear magnetic resonance and electron paramagnetic resonance techniques. Various physical properties were determined including solubility, heat of solution, vapor pressure, viscosity, density, sonic velocity, conductance, diffusion coefficient, and dielectric constant. Author

N69-36495# Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
THE KINETICS OF OXIDATION OF ISOPROPYL BENZENE BY MOLECULAR OXYGEN
R. Priiman et al May 1969 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk Eston. SSR, Ser. Khim. i. Biol. (Tallinn), v. 16, no. 2, 1967 p 116–120
(AD-688249; PA-TT-158) Avail: CFSTI CSCL 7/3

In order to develop the methods of removing detergent impurities and original substances from the waters and tailings of chemical enterprises it is necessary to have the information about the kinetics and about the elementary mechanism of their oxidation under natural conditions--in a neutral medium with molecular oxygen taking part at a comparatively low temperature and in the absence of catalytic agents. This report describes briefly the results of the first stage of such an investigation which carried out the oxidation of the simplest representative of the alkyl-aromatic hydrocarbons--isopropyl benzene (cumene). Author (TAB)

N69-36499# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.
BOMBARDMENT OF PYROLYTIC CARBON WITH NOBLE GAS IONS IN THE ENERGY RANGE OF 10-45 keV
G. Betz, R. Dobrozemsky, F. P. Viehboeck, and H. Wotke 1969 6 p refs Submitted for publication
(SGAE-PH-83/1969) Avail: CFSTI

The behavior of pyrolytic carbon under bombardment of 10 45 keV singly charged ions of Ar^{40}, Kr^{84}, Xe^{132} was investigated. The sputtering coefficient, the angular distribution of the sputtered material for oblique incidence in two special cases, and the coefficient for secondary electron emission were measured. A rather unexpected result, a preferred emission of sputtered material in the forward direction, was found. Author

N69-36536# Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.
RADIOTRACER PROCEDURES FOR MECHANISTIC STUDIES IN AIR POLLUTION RESEARCH
Marvin L. Whisman and Basil Dimitriades Oct. 1969 41 p refs
(BM-RI-7304) Avail: Issuing Activity

Radiotracer techniques were developed for stoichiometric studies of photochemical reactions associated with atmospheric smog formation. Stock blends of separate hydrocarbon and oxygenated compounds were prepared and calibrated. C^{14}-labeled reactants and products in reaction systems involving hydrocarbons and nitrogen oxides at the ppm level were analyzed for qualitative and quantitative data. Precision and accuracy of these methods were determined by replication and statistical treatment of data, and these methods are described. Author

N69-36648# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Chemie.
CHROMATOGRAPHIC BEHAVIOUR AND CHEMICAL STRUCTURE. PART 1: THIN-LAYER CHROMATOGRAPHY OF ALIPHATIC ACIDS
F. Guetlbauer and K. Wess 1969 18 p refs Submitted for publication
(SGAE-CH-67/1969) Avail: CFSTI

About sixty aliphatic acids, predominantly fatty acids, hydroxy acids, amino acids, and halogen acids, were separated on cellulose layers with the solvent mixture n-butanole - diethylamine - water (85:1:14). The R_M values, $R_M = \log (1/R_F - 1)$, thus obtained exhibit in most cases the validity of Martin's theoretical postulates for the relationship between chemical structure and R_F value in partition chromatography. Thus when R_M is plotted against the number of substituent groups of any one kind a close approximation to linearity results, except in the case of acids with vicinal hydrophilic groups. The calculation of group constants and binding increments was done by direct comparison of the R_M values of substances differing by only one group or increment. These data facilitate chromatographic elucidation of structural problems requiring only very small substances not even isolated in pure form. Author

N69-36669# California Univ., Santa Barbara. Dept. of Chemistry.
FLUORESCENCE LIFETIMES OF PYRENE MONOMER AND EXCIMER AT HIGH PRESSURES
J. J. Kim, R. A. Beardslee, D. T. Phillips, and H. W. Offen 2 Jan. 1969 7 p refs Submitted for publication
(Contract N00014-67-A-0120)
(AD-688928; TR-17) Avail: CFSTI CSCL 7/5

The fluorescence lifetimes of a number of aromatic hydrocarbons are shortened by 15-40% when the matrix is compressed by 30 kbar pressure. The causes of environmentally-induced lifetime shortening may be further illuminated by a detailed study of one solute under a variety of conditions. The document reports on such a study of pyrene and in addition, compares the pressure-enhanced electronic relaxation for the monomeric and excimeric forms of pyrene. The work established the magnitude of environmental influences on the singlet lifetime of pyrene and demonstrated a remarkable insensitivity of the emitting species to the nature of the microscopic surroundings, be it monomer or excimer. TAB

N69-36678# Army Foreign Science and Technology Center, Washington, D.C.
SYNTHESIS OF CERTAIN LINEAR AND CYCLIC S-OXIDES OF DISULFIDES (THIOSULFONATES)
V. N. Fedoseeva and V. E. Petrulkii May 1969 9 p refs Transl. into ENGLISH from Ukr. Khim. Zh., (Kiev), v. 33, no. 5, 1967 p 492–494
(AD-688080; FSTC-HT-23-976-68) Avail: CFSTI CSCL 7/3

The paper describes the synthesis of five linear and cyclic esters of thiosulfinic acids (thiosulfonates) containing a sulfosodium group. They can be quantitatively determined by using the ability of the thiosulfonates to oxidize hydrogen iodide to iodine. The reaction of the S-oxides of bis (2-sodium sulfoethyl) disulfide with cysteine produced 2,2-carboxyaminoethyl-2-sulfoethyl disulfide. Author (TAB)

N69-36692# Imperial Chemistry Industries, Ltd., Wilmslow (England). Management Services.
REPORT ON THE APPLICATION OF AIA ON A SET OF POLYMERISTATION EQUATIONS

A. K. Datta 17 Sep. 1968 7 p refs
(MSDH/68/123) Avail: CFSTI

The purpose of this report is to demonstrate the efficiency and effectiveness of the A.I.A. in the integration of a set of stiff polymerisation differential equations over a sufficiently long range showing significant changes in the variables due to the larger time constants of the system. The conventional methods like Kutta – Merson procedure would require prohibitive amount of computing time to integrate over a long range due to the restriction in step size for stability. Author

N69-38752# Naval Research Lab., Washington, D.C. Chemistry Div.
SOLUBILITY OF NICKEL IN LIQUID SODIUM OF HIGH OXIDE CONTENT Final Report
T. A. Kovacina and R. R. Miller 20 May 1969 17 p refs
(AD-688780; NRL-6890) Avail: CFSTI CSCL 07/4

The influence of oxide content on the solubility of Ni in liquid Na at 400C was investigated. The solubility of Ni increased with increasing oxide content of the Na up to the saturation level of Na2O in Na. The temperature-dependent-equilibrium solubility of Ni in liquid Na saturated with Na2O (oxygen added as NiO) was found to vary between 4 ppm at 300C and 21 ppm at 500C. The soluble species is postulated to be a compound of the type (NiO)x (Na2O)y. TAB

N69-38760# Chemical Lab. RVO-TNO, Rijswijk (Netherlands).
MULTILAYER ADSORPTION ON CARBON ADSORBENTS
J. G. T. van Aken Nov. 1968 43 p refs
(Rept-1968-20; TDCK-52672) Avail: CFSTI

The adsorption of nitrogen, benzene and carbon tetrachloride on carbon blacks and ground graphites in the multilayer region have been analyzed with the t-method. The t-curves for these adsorbates were determined on samples from which the micropores were removed by treatment in pure hydrogen at 1000–1100°C. The surface properties of the untreated samples were investigated by analysis of the adsorption isotherms with the t-method. This revealed the presence of micropores and narrow pores. Adsorption isotherms of nitrogen on ice and on carbon covered with ice were also analysed with the t-method. The comparison of the multilayer formation of nitrogen, benzene and carbon tetrachloride on homogeneous and heterogeneous surfaces offered strong evidences for the incorrectness of the results obtained with the BET equation from benzene and carbon tetrachloride adsorption isotherms. Author

N69-38797# California Univ., Los Angeles. Dept. of Chemistry.
SPACE CHEMISTRY IN THE 1970'S
Willard F. Libby *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 431–460 refs (See N69-36776 21-04)
Avail: CFSTI

The contributions of chemistry to the aerospace effort are considered in five principal areas: (1) high pressure effects on liquids and solids; (2) radiation chemistry; (3) high temperature behavior of liquids and solids and techniques for determining these reactions; (4) vacuum chemistry; and (5) the chemical aspects of the evolution and nature of planetary atmospheres, particularly those of Jupiter and Venus. A.C.R.

N69-38839# Joint Publications Research Service, Washington, D.C.
CYBERNETICS METHODS IN CHEMISTRY AND CHEMICAL TECHNOLOGY
V. V. Kafarov 27 Aug. 1969 66 p Transl. into ENGLISH from the book "Metody Kibernetiki v Khimii i Khimicheskoy Tekhnologii" USSR, Khimiya Press, 1968 p 11–60
(JPRS-48701) Avail: CFSTI

The application of cybernetic methods and techniques to the investigation of technical systems pertaining directly to chemistry and chemical technology is discussed. Author

N69-38902 Connecticut Univ., Storrs.
ELECTRON SPIN RESONANCE STUDIES OF GAMMA-RAY AND ELECTRON IRRADIATED CALCIUM MOLYBDATE
William Eng (Ph.D. Thesis) 1968 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-2120

Single crystals of calcium molybdate were subjected to gamma-rays and fast electron irradiation at 77°K. The radiation effects were studied by electron spin resonance and optical absorption techniques. No displacement type of defects were found in calcium molybdate, even with 1-MeV electron irradiation. The experimental findings in the radiation effects in calcium molybdate parallel that of calcium tungstate in most cases. Two classes of crystal were employed in the experiments. One class of crystal is stoichiometric; the other is non-stoichiometric having oxygen vacancies. The stability of the defects in the two classes of crystal is different. The presence of oxygen vacancies causes the electron-like defects to be stable to a higher temperature, and also prevents these defects from being optically bleached. Furthermore, there are evidences suggesting that the electron-like defect is associated with an impurity ion, and that the hole-like defect is associated with lattice strain. In addition, a new defect was observed which has an isotropic g value slightly greater than that of the free electron, and which exhibits a four-line isotropic hyperfine structure. It is believed to be a delocalized hole associating with oxygens and stabilized near a sodium impurity substituting for a normal cation. Dissert. Abstr.

N69-38972# Purdue Univ., Lafayette, Ind. Project Squid Headquarters.
HIGH PRESSURE MASS SPECTRA AND ION CHEMISTRY OF CARBON DIOXIDE
J. L. Franklin (Rice Univ.), and S. M. Schildcrout (Rice Univ.) May 1969 26 p refs
(Contract N00014-67-A-0226)
(AD-688175; SQUID-TR-RICE-5-PU) Avail: CFSTI CSCL 7/4

A mass spectrometric study of ion-neutral reactions occurring in CO2 subjected to electron impact yields rates in agreement with previous studies for reaction of C(+) and O(+) with CO2. Charge transfer from O(+) to CO2 is believed to compete with formation of O2(+) in these experiments. Charge transfer from CO(+) to CO2 is found to be somewhat faster than previously reported. An approximate rate has been obtained for loss of CO2(++). The great abundance of C2O4(+) in this system at pressures near 1 torr results from reaction of CO2(+) with several CO2 molecules. This reaction is not well understood but a mechanism involving stepwise ion polymerization followed by collision induced decomposition of the complex to C2O4(+) is suggested. Author (TAB)

N69-37024*# Notre Dame Univ., Ind. Dept. of Chemistry.
SYNTHESIS OF POLYMERS WITH HIGH RESIDUES AT HIGH TEMPERATURES
G. F. D'Alelio 31 Jul. 1969 11 p
(Grant NGR-15-004-028)
(NASA-CR-105752) Avail: CFSTI CSCL 07C

Several polymers are selected, synthesized, and evaluated for their residue contents. The polymers were derived from *m*-phenylenediamine, pyromellitic dianhydride, and mellitic

tridiarylhydride. The polymerizations were performed as solutions in N, N-dimethyl acetamine. The yields of the polymers were calculated on the basis of the hemi-amic acid form. Results indicate the yields correspond to theoretical data. E.H.W.

N69-37059# National Aeronautical Establishment, Ottawa (Ontario).

DIFFUSION OF Cr-51 INTO POLY- AND SINGLE CRYSTALS OF NIOBIUM

J. Pelleg and G. M. Lindberg Nov. 1968 52 p refs
(AD-689-476; LR-511; NRC-10636) Avail: CFSTI CSCL 7/4

Using a microsectioning technique, the diffusion of 51Cr into niobium poly- and single crystals has been measured over the temperature range 947C - 1493C. Deviations from ideal Gaussian penetration curves were observed at lower temperatures, indicating possible short-circuit diffusion paths. Observations similar to these have been reported for Nb and Ta and are believed to result from structural defects in the crystal. The results are discussed in terms of current theories for impurity diffusion. Author (TAB)

N69-37060# Pennwalt Corp., King of Prussia, Pa. Research and Development Dept.

NEW MATERIALS FROM HIGH-PRESSURE HIGH-TEMPERATURE PROCESSES Final Report, 22 Apr. 1966 – 21 Apr. 1969

M. S. Silverman, W. H. Chappell, Jr., and J. R. Soulen May 1969 5 p refs
(Contract DA-31-124-ARO(D)-362)
(AD-688948; AROD-3706-5-C) Avail: CFSTI CSCL 7/2

High-pressure (to 80 kbar) high-temperature (to 2500C.) synthesis work to obtain entirely novel chemical compositions and structures briefly is reviewed. Much of the work was devoted to identification and characterization of new sulfides and selenides, and determining the conditions under which these materials are formed. The crystal structure and superconducting behavior of a new high temperature polymorph of CaSi2 was investigated. Author (TAB)

N69-37063# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.

MOLECULAR DYNAMICS AND STRUCTURE OF SOLIDS

R. S. Carter, ed. and J. J. Rush, ed. Jun. 1969 547 p refs Papers Contrib. to the 2d Mater. Res. Symp., Gaithersburg, Md., 16 – 19 Oct. 1967
(NBS-Spec-Publ-301) Avail: SOD $4.00

The topics discussed include the application of spectroscopic and diffraction techniques to the study of the structure and dynamics of molecular solids, including neutron and X-ray diffraction, neutron inelastic scattering, infrared and Raman spectroscopy, and nuclear magnetic resonance. For individual titles see N69-37064 through N69-37120.

N69-37064# Rochester Univ., N.Y.

THEORETICAL BASIS OF TECHNIQUES FOR THE INVESTIGATION OF MOLECULAR DYNAMICS AND STRUCTURE OF SOLIDS

Elliot W. Montroll *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 3 – 56 refs (See N69-37063 21-06)
Avail: SOD $4.00

Factors supporting experimental techniques used in studies of the structure and molecular dynamics of solids are reviewed as follows: (1) thermodynamic properties, including heat capacity measurements, lattice vibrations, other degrees of freedom, and residual entropy of molecular crystals; (2) scattering techniques, including inelastic neutron scattering, elastic scattering by correlated scattering centers, scattering by an assembly of identical scatterers, X-ray scattering of molecular crystals, scattering of electromagnetic waves by special and temporal fluctuations in a medium, and time dependent correlations and the spectrum of scattered light; (3) relaxation and resonance techniques, including dielectric relaxation, and nuclear magnetic resonance experiments; (4) infrared spectra, including diatomic molecules, polyatomic molecules, and crystal lattices. E.C.

N69-37069# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.

SPECTROSCOPE AND DIFFRACTION STUDIES OF SIMPLE HYDROGEN BONDS IN SOLIDS

James A. Ibers *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 177 – 191 refs Sponsored by ARPA (See N69-37063 21-06)
Avail: SOD $4.00

Criteria for hydrogen bonding are mentioned and studies of simple hydrogen bonding systems in the solid state are summarized. Study topics are: neutron diffraction and symmetric (or almost symmetric) AHA bonds; ClHCl and BrHBr ions; isotope effects in hydrogen bonding; and chromous and cobaltous acid systems. E.C.

N69-37070# Brookhaven National Lab., Upton, N.Y. Dept. of Chemistry.

STRUCTURE AND DYNAMICS IN MOLECULAR CRYSTALS: SOME COMPARISONS

Walter C. Hamilton *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 193 – 218 refs Sponsored by AEC (See N69-37063 21-06)
Avail: SOD $4.00

Molecular dynamics and neutron and X-ray diffraction and neutron inelastic scattering studies are considered. The desirability of using complimentary techniques and the importance of models are emphasized. Future prospects of neutron inelastic scattering studies as applied to chemical problems are discussed. Results of molecular dynamics studies of hydrogen bonded systems (phosphonium iodide, ammonium fluorosilicate, and potassium hydrogen bisacetylsalicylate) are reviewed. E.C.

N69-37071# Montana State Coll., Bozeman. Dept. of Physics.

DYNAMICAL EFFECTS OF DEUTERON INTRABOND JUMPING IN KD SUB 2 PO SUB 4

V. Hugo Schmidt *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 219 – 222 refs Sponsored in part by Natl. Inst. of Health (See N69-37063 21-06)
Avail: SOD $4.00

Four dynamical effects of motion of deutrons within hydrogen bonds in KD_2PO_4 are discussed. These effects are an additional splitting of the deuteron magnetic resonance spectrum below the ferroelectric Curie temperature T_c, a contribution to the deuteron spin-lattice relaxation, dielectric behavior at microwave frequencies, and ferroelectric domain wall motion. Author

N69-37073# Louvain Univ. (Belgium). Laboratoire de Physico-Chimie Minerale.

PROTON DELOCALIZATION IN INORGANIC SOLIDS

J. J. Fripiat, P. G. Rouyhet, H. Jacobs, and A. Jelli *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 227 – 231 refs (See N69-37063 21-06)
Avail: SOD $4.00

Infrared spectroscopy was used to study solids containing hydroxyl groups for lattice defects arising from proton delocalization. In these solids, heated progressively to elevated temperatures, a decrease of the integrated intensities of the stretching as well as of the deformation and torsion OH bands was observed, the initial intensity being fully restored on cooling the sample. Micas, boehmite, and decationed zeolites were discussed. Author

N69-37074# Technische Hogeschool, Delft (Netherlands). Laboratorium voor Technische Natuurkunde.

STRUCTURE REFINEMENTS, THERMAL MOTION AND MADELUNG CONSTANTS OF CDI SUB 2- AND CD(OH) SUB 2 - TYPE LAYER STRUCTURES

Y. M. De Haan *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 233–236 refs (See N69-37063 21-06)
Avail: SOD $4.00

The molecular structure of halides and hydroxydes of bivalent metals are briefly discussed. Crystallographic data and Madelung factors for NiI_2, $NiCl_2$, CdI_2, $Cd(OH)_2$, and $Ca(OH)_2$ are presented in tabular form. The Madelung constant is also proved related to the coulomb energy per molecule. J.A.M.

N69-37075# Argonne National Lab., Ill. Metallurgy Div.

THE AQUATED HYDROGEN ION: SINGLE CRYSTAL DIFFRACTION INVESTIGATIONS OF COMPOUNDS CONTAINING THE (H SUB 2O•H•OH SUB 2) PLUS ION

Jack M. Williams *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 237–240 refs Sponsored by AEC (See N69-37063 21-06)
Avail: SOD $4.00

The results of several single crystal neutron and X-ray diffraction studies and infrared spectroscopic studies have verified the existence of the $(H_2O•H•OH_2)^+$ ion in the crystalline state. A summary of single crystal diffraction studies of compounds containing this ion are presented in tabular form. Author

N69-37076# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.

INFRARED INVESTIGATION OF ORDERING AND STRUCTURAL CHANGES IN AMMONIUM HALIDES

G. W. Garland and N. E. Schumaker *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 241–243 refs (See N69-37063 21-06)
Avail: SOD $4.00

Ammonium chloride and ammonium bromide underwent transitions involving the relative orientations of the ammonium ions. Temperature effects on structural changes in ammonium halides and the order-disorder nature of lambda transitions are briefly discussed. J.A.M.

N69-37077# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.

NUCLEAR MAGNETIC RESONANCE AND NEUTRON-SCATTERING STUDIES OF HINDERED ROTATION IN PHOSPHONIUM IODIDE

T. C. Farrar and J. J. Rush *In its* Mol. Dyn. and Struct. of Solids Jun. 1969 p 245–248 refs (See N69-37063 21-06)
Avail: SOD $4.00

Phosphonium and ammonium salts were compared, and a motion study of these salts by nuclear magnetic resonance provided data on the potential energy surfaces in these crystals. The results of preliminary line-width and T_1 measurements of phosphonium iodide were compared to neutron scattering results for phosphonium iodide and the ammonium halides. Author

N69-37078# Brookhaven National Lab., Upton, N.Y. Dept. of Chemistry.

A NEUTRON DIFFRACTION STUDY OF LITHIUM PERCHLORATE TRIHYDRATE

A. Sequeira (Atomic Energy Estab., Bombay) and Ivan Bernal *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 249–251 refs Sponsored by AEC (See N69-37063 21-06)
Avail: SOD $4.00

A set of empirical rules which characterize the behavior of the electrolytes with respect to solvents is summarized. The ability of an ion to form stronger hydrogen bonds with water using single crystal neutron diffractometry is reported. J.A.M.

N69-37079# Argonne National Lab., Ill.

THE STRUCTURE OF SEVERAL URANYL NITRATE COMPOUNDS AS DETERMINED BY NEUTRON DIFFRACTION

M. H. Mueller and N. Kent Dalley *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 253–255 refs Sponsored by AEC (See N69-37063 21-06)
Avail: SOD $4.00

Neutron diffraction in the crystal structure of uranyl nitrates was employed to obtain accurate positions for light atoms and to study hydrogen bonding present in each compound using the atomic scattering factor ratios. The thermal motion in these compounds is summarized. J.A.M.

N69-37080# Temple Univ., Philadelphia, Pa. Dept. of Chemistry.

INFRARED SPECTRAL STUDIES AS A TOOL FOR SENSING THE ENVIRONMENT ABOUT WATER MOLECULES IN HYDRATES

J. Schiffer and D. F. Hornig *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 257–259 refs Prepared in Cooperation with Office of Science and Tech. (See N69-37063 21-06)
Avail: SOD $4.00

The isotope dilution technique has proven useful for sensing the environment about water molecules in hydrates. In principle, it involves recording vibrational spectra of hydrates, containing varying admixtures of water, HOD, and deuterium oxide. Four specific examples drawn from the infrared spectra of the hydrates of NaCl, NaBr, $CaSO_4$, $BaCl_2$, and their deutero-analogs are discussed. A.L.

N69-37081# British Columbia Univ., Vancouver. Dept. of Chemistry.

NUCLEAR MAGNETIC RESONANCE STUDIES OF MOLECULAR MOTION IN CLATHRATE HYDRATES

C. A. Mc Dowell and P. Raghunathan *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 261–263 refs Sponsored in part by Natl. Rs. Council of Canada (See N69-37063 21-06)
Avail: SOD $4.00

Results pertaining to the temperance-dependence of NMR line shapes and spin-lattice relaxation times for a variety of molecules enclathrated in hydrate structures are summarized. Results were obtained with a crossed coil, wide line NMR spectrometer operated at 30 MHz. The resonance line shapes were rationalized on the basis of precise calculations of theoretical second moments for various dynamical models of the guest molecules. These calculations consisted of intra-guest second moment contributions from a single host lattice cavity as well as interguest contributions for all occupied cavities in the neighborhood. Results indicate that, at least in specific cases, refinements to the currently existent approximations of spherically-symmetric host cages are necessary. Author

N69-37082# Pittsburgh Univ., Pa. Dept. of Physics.
CALCULATION AND ANALYSIS OF PULSED-NMR LINE SHAPES OF CRYSTALS
Marcel Kopp *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 265–267 refs Sponsored in part by NSF (See N69-37063 21-06)
Avail: SOD $4.00

This research was conducted to determine what structural information can be derived about the intra- and inter-molecular configurations in ice from its nuclear magnetic resonance line shapes. The methods were tested on fluorite, a simple cubic spin lattice, and on gypsum and hydrogen sulphide, simple hydrates, and may be applied to other suitable hydrates or molecular crystals. Author

N69-37083# National Research Council of Canada, Ottawa (Ontario). Div. of Pure Chemistry.
THE VAPOR PRESSURES OF CO/N SUB 2 SOLID SOLUTIONS
J. A. Morrison, D. M. T. Newsham, and R. D. Weir *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 269–271 refs (See N69-37063 21-06)
Avail: SOD $4.00

This investigation continues previous work in which some thermodynamic properties of condensed CO (accidentally containing about 2.6 percent N_2) were measured. Deviations from the properties of pure CO were used to make some deductions about the behavior of the solution of N_2 in CO in the region of the λ-type transition that occurs in the pure substances and in the solutions. Because of the close similarity of N_2 to CO with respect to mass, molecular properties and crystal structure, substitution of N_2 into the CO lattice does not perturb the solid too severely. This report is concerned only with vapor pressures of the solutions; no other thermodynamic properties have been measured. Two different measuring techniques have been used with the same apparatus. The second technique was developed to circumvent difficulties encountered in the attainment of equilibrium in the solutions in the region $T/T_m < 0.97$(melting point). Author

N69-37088# Rensselaer Polytechnic Inst., Troy, N.Y. General Electric Co., Schenectady, N.Y.
EPITHERMAL NEUTRON INELASTIC SCATTERING FROM METAL HYDRIDES
S. S. Pan, M. L. Yeater, and W. E. Moore *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 315–318 refs Prepared in Cooperation with GE Sponsored by AEC (See N69-37063 21-06)
Avail: SOD $4.00

Recent neutron scattering research conducted at the Rensselaer Polytechnic Institute scattering facility is discussed. This facility is designed to study the interactions of neutrons with molecular systems by measuring the energy and angle dependence of the inelastic scattering cross section. Comparisons are made between theory and experiment to provide a critical test of a given molecular or atomic vibration model, and indirectly verify certain aspects of the molecular structure. Specific examples of experiments conducted on zirconium, titanium, and niobium hydrides are presented. A.L.

N69-37089# Army Materials and Mechanics Research Center, Watertown, Mass.
VIBRATION SPECTRA OF HYDRIDES POSSESSING THE CUBIC PEROVSKITE STRUCTURE BY THE INELASTIC SCATTERING OF COLD NEUTRONS
Arnulf J. Maeland *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 319–322 refs (See N69-37063 21-06)
Avail: SOD $4.00

Experimental procedures and results are reported for experiments conducted to obtain the vibration spectra of $BeLiH_3$ and $SrLiH_3$ by the energy gain scattering of cold neutrons. Both of these hydrides have been confirmed to possess the perovskite structure. Infrared transmission spectra have also been obtained to supplement the neutron data and assist in the identification of the vibration frequencies. Author

N69-37096*# Massachusetts Inst. of Tech., Cambridge. Spectroscopy Lab.
OPTICAL PHONONS IN MIXED SODIUM POTASSIUM TANTALATES
T. G. Davis, N. E. Tornberg, C. H. Perry, and N. Knable *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 343–347 refs Prepared in cooperation with NASA (See N69-37063 21-06)
(Contracts ARPA SD-90; DA-28-043-AMC-02536(E); Grant NSF GP-4923)
Avail: SOD $4.00 CSCL 07D

The structures of mixed sodium potassium tantalate crystals as functions of temperatures were studied by infrared and Raman spectroscopy. A strongly temperature dependent peak in the low frequency conductivity shift to longer wavelengths was observed in paraelectric mixed crystals when the temperature was lowered toward the Curie temperature. Raman spectra showed that most of the second-order bands increased in frequency as sodium content increased. It was concluded that for all sodium concentrations in the paraelectric phase, the Raman spectrum is a combined density of states curve and indicates the phase transitions present. G.G.

N69-37097# California Univ., Los Angeles. Dept. of Chemistry.
DIFFRACTION STUDIES OF MOLECULAR DYNAMICS IN ORGANIC CRYSTALS
K. N. Trueblood *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 355–379 refs (See N69-37063 21-06)
Avail: SOD $4.00

Reviewed are recent studies on motion of individual molecules and parts of molecules in crystals and the mechanisms of some reactions in the solid state. Included are a few examples from precise structural analyses to illustrate the sorts of patterns of molecular dynamics that can be obtained from diffraction data. The rigid body model was generally used to determine atomic temperature factors after least square analysis. The only exceptions are for nitro groups and for naphtalene and anthracene. G.G.

N69-37098# Oak Ridge National Lab., Tenn. Chemistry Div.
INFORMATION ON MOLECULAR MOTION DERIVED FROM ANISOTROPIC TEMPERATURE FACTOR COEFFICIENTS
Carroll K. Johnson *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 381–384 refs Sponsored by AEC (See N69-37063 21-06)
Avail: SOD $4.00

The anisotropic temperature factor (ATF) coefficients derived through a crystal-structure analysis describe the time-averaged mean-square displacement in 3-space for each crystallographically distinct atom in the crystal. Correlations between the displacements of different atoms are not experimentally obtainable from X-ray or neutron Bragg reflection data. Consequently, it is necessary to adopt a model which fixes the interatom correlations of motion in order to formulate a description of overall molecular motion from the ATF coefficients. The simplest possible model for molecular motion is the rigid-body model in which all intramolecular interatomic distances are held constant. A recent detailed analysis of the mathematics for rigid-body motion of a molecule in a crystal is given

by Schomaker and Trueblood. If the time-averaged mean-square amplitudes of displacement due to internal molecular vibration in the same molecule or a similar molecule are known, the effect of these displacements can be subtracted from the observed ATF coefficients before fitting the rigid-body model. Author

N69-37099# Brookhaven National Lab., Upton, N.Y. Dept. of Chemistry.
INFLUENCE OF BONDING EFFECTS ON THERMAL PARAMETERS AS DETERMINED BY X-RAY DIFFRACTION
Philip Coppens *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 385-388 refs Sponsored by AEC (See N69-37063 21-06)
Avail: SOD $4.00

The X-ray temperature parameters obtained in conventional least-squares refinement using a free-atom model will generally contain contributions resulting from asymmetry of the valence electrons due to bonding. An experimental measure of the effect is obtained by comparative X-ray and neutron diffraction analyses. The few analyses of sufficient accuracy which have been undertaken indicate that the effect is appreciable at least for first row atoms. The X-ray temperature factors for first row atoms are therefore of limited usefulness in the study of molecular dynamics. Author

N69-37102# California Univ., Riverside. Dept. of Chemistry.
THE CRYSTAL AND MOLECULAR STRUCTURE OF TETRAETHYLAMMONIUM BIS-(3)-1,2-DICARBOLLYLCUPRATE(II)
Richard M. Wing *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 397-401 refs (See N69-37063 21-06)
Avail: SOD $4.00

Descriptive chemistry of a newly isolated blue crystalline compound, tetraethylammonium bis-(3)-1,2-dicarbollylcuprate(II) and its ionic crystal structure are reported. The triclinic crystals with one formula unit per cell were analyzed for molecular framework, cage carbons, a molecular 2-fold axis, valence bonding, and slip distortion causes. Interaction of the copper and carbon atoms was minimal if present at all and the system was not clearly an organometallic one. M.H.E.

N69-37103# State Univ. of New York, Stony Brook. Dept. of Chemistry.
NUCLEAR MAGNETIC RESONANCE STUDIES OF SINGLE CRYSTALS OF TRICHLOROACETIC ACID
David C. Haddix and Paul C. Lauterbur *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 403-406 refs Sponsored in part by NSF (See N69-37063 21-06)
Avail: SOD $4.00

A trichloroacetic acid crystal is studied by nuclear magnetic resonance spectroscopy in an investigation of proton magnetic shielding, shielding tensor quantity, and its contribution to hydrogen-proton bonding and shielding anisotropy. Spectra were obtained at 100 MHz, and rotated vertically about an arbitrary axis. Shielding plot analysis for principal-axis systems of the shielding tensors were obtained by computer. Results are tentative but the apparent deviation from axial symmetry and observations on the non-planar orientation of the dimers requires further lattice study. M.H.E.

N69-37104# Dow Chemical Co., Midland, Mich. Chemical Physics Research Lab.
THERMAL AND COMPOSITION EXPANSION OF CLATHRATES IN THE ETHYLENE OXIDE-WATER SYSTEM
J. A. McIntyre and D. R. Peterson *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 407-410 refs (See N69-37063 21-06)
Avail: SOD $4.00

Using ethylene oxide and water as clathrate hydrate examples, this study further defines the variability in composition of these compounds. Compared to other studies in which variable composition was determined by observed density values, this study demonstrates a more positive relationship between unit cell parameter as a function of temperature and variability in composition. Thermal expansion relation by X-ray diffraction are established over −140° to −20°C for samples containing 2.3, 4.8, 9.3, and 12.8 mole% ethylene chloride. Concentrations of guest molecules per unit cell and temperature relationships effecting composition were calculated. M.H.E.

N69-37105# Nottingham Univ. (England). Dept. of Physics.
NUCLEAR MAGNETIC RESONANCE AND MOLECULAR MOTION IN ORGANIC CRYSTALS
E. R. Andrew *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 413-435 refs (See N69-37063 21-06)
Avail: SOD $4.00

A representative group of related organic solids in which molecular reorientation about one preferred axis had been examined by the nuclear magnetic resonance method is discussed. Experiments in which narrowing of N.M.R. spectra of solids is achieved by rapidly spinning the specimens, since this gives insight into the narrowing mechanism and lends support to the underlying ideas are presented. A group of organic solids in which not only is the molecule as a whole capable of rotational motion, but in which there is also rotational motion of groups within the molecule are considered. Solids are discussed in which as the temperature is raised progressively more general motions of the molecules are excited, which leads to a discussion of the diffusion of molecules in solids. Finally, the way in which quadrupole effects can provide information about molecular motion in solids is investigated. Author

N69-37106*# South Carolina Univ., Columbia. Dept. of Chemistry.
FAR INFRARED SPECTRA AND SPACE GROUP OF CRYSTALLINE HYDRAZINE AND HYDRAXINE-D SUB 4
F. G. Baglin, S. F. Bush, and J. R. Durig *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 437-440 (See N69-37063 21-06)
(Grant NGR-41-002-003)
Avail: SOD $4.00 CSCL 07D

The infrared spectra of crystalline hydrazine and hydrazine-d_4 have been recorded from 33-400 cm^{-1}, and are shown in charts. All spectral bands are assigned to lattice vibrations according to whether they arise primarily from a translational or a librational mode. Seven bands were observed in the far-infrared spectrum of crystalline hydrazine, and their frequencies are listed. All three of the translational modes predicted from group theory are assigned and four of the six predicted librations are also assigned. The assignments were accomplished on the basis of similar band contours and isotopic shift data obtained from hydrazine-d_4. The space group of crystalline hydrazine was found to be C^2_2 on the basis of the number of bands observed in the lattice region of the spectrum, and it is believed that far infrared data should be useful in the solution of similar structural problems. Author

N69-37109# Kyoto Univ. (Japan). Dept. of Chemistry.
THEORY OF PHASE TRANSITIONS IN SOLID METHANES

Tsunenobu Yamamoto, Yosuke Katsoka, and Hideo Yasuda *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 453–456 refs (See N69-37063 21-08)
Avail: SOD $4.00

A quantum mechanical study of the James–Keenan model with special emphasis on application to solid methane is presented. Each of three nuclear spin species A, E, and T were treated separately under the assumption of no interspecies conversion. Then two kinds of mixture of nuclear spin species, normal and equilibrium, were treated with and without the assumption, respectively. All the calculations were carried out in the framework of the molecular-field approximation method. The upper transition lines of both CH_4 and CD_4[2] are shown. The calculations were made in the subspace with $J \leq 9$, J being the rotational quantum number, which is sufficient so long as the phenomena remain below 30°K. The value of the coupling parameter at zero pressure can be determined so that the equilibrium mixture of CH_4 has its transition at 20.4°K, the observed upper transition temperature. Author

N69-37110# Naval Research Lab., Washington, D.C.
NMR RELAXATION IN ADAMANTANE AND HEXAMETHYLENETETRAMINE: MOLECULAR ROTATION AND DIFFUSION
H. A. Resing *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 457–458 refs (See N69-37063 21-08)
Avail: SOD $4.00

Nuclear magnetic resonance relaxation time of adamantane and hexamethylenetetramine (HMT) have been analyzed for the purpose of assesing molecular diffusion and rotation. The plastic behavior differences between the two being extreme, diffusion coefficients were calculated and demonstrated five orders of magnitude of diffusional jump in adamantane greater than that for hexamethylenetetramine at 270°C. Melting point rotational jumps for both affirmed the higher rotational barrier in HMT and consequently its closer harmonic approximation. M.H.E.

N69-37111# Michigan Univ., Ann Arbor. Dept. of Chemistry.
THERMODYNAMIC APPROACH TO MOLECULAR FREEDOM, ESPECIALLY IN PLASTICALLY CRYSTALLINE SUBSTANCES
Edgar F. Westrum, Jr. *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 459–462 refs (See N69-37063 21-08)
Avail: SOD $4.00

Transition data on crystals formed by symmetrical-top globular molecules are presented, with a discussion on the entropy change in the case of succinonitrile. In solid–solid transitions in which order–disorder effects predominate, this change may be approximated by $\Delta St = R \ln Q$, where Q is the ratio of the number of orientational states statistically occupied in the two phases. Although great success in using thermodynamic techniques in determinations of molecular structures has been achieved, this work has been done largely on gaseous molecules. A method for determining barrier heights exclusively from crystalline-phase heat capacities was developed which is in good accord with values for both gases and crystals, despite the fact that barriers in the crystalline state potentially involve intermolecular forces that are absent in the gaseous phase. A similar ΔSt approach has also been used on ionic crystals. A.C.R.

N69-37113# National Lead Co., Hightstown, N.J. Dept. of Chemical Physics.
ANISOTROPIC LATTICE DYNAMIC STUDIES OF ORGANOTIN COMPOUNDS BY MOESSBAUER SPECTROSCOPY
Hans A. Stoecklar and Hirotoshi Sano *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 469–472 refs Prepared in Cooperation with Ochanomizu Women's Univ. (See N69-37063 21-08)
Avail: SOD $4.00

A typical organo-tin layer structure, $[(CH3)_2SnO]_n$, is analyzed. The tin in dimethyltinoxide is penta-coordinated with three nearest-neighbor oxygen atoms to form a two dimensional, polymeric CdI_2-type layer lattice, with a well ordered intermolecular arrangement. The isomer shift and quadrupole splitting data obtained support an earlier conclusion that the tin-oxygen bond is relatively ionic, with perhaps a minimum dative bond character. This gives rise to a pseudo-ionic lattice structure. The material in this analysis is compared with a typical monomeric, trigonal, bipyramidal, covalent compound $(CH_3)_3SnCl$. pyridine. A.C.R.

N69-37114# Bell Telephone Labs., Inc., Murray Hill, N.J.
RELAXATION IN SOLID POLYMERS
David W. Mc Call *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 475–537 refs (See N69-37063 21-08)
Avail: SOD $4.00

Present knowledge relating to molecular motions in solid polymers is summarized for organic materials with high molecular weight in the glassy, crystalline, and rubbery states. Oriented substances are not discussed. It is concluded that: (1) Relaxation frequencies are not very sensitive to morphological detail, although for further experimental characterization of the intensities it will be necessary to pay close attention to morphology and other structural features. (2) Assignments of molecular mechanisms for a polymer can usually be made intuitively and checked by comparisons with related polymers and estimates of the magnitudes of relaxation parameters; such a procedure is less formal, but basically similar to the assignment of resonance spectra. (3) Once a molecular mechanism has been distinguished, the relaxation can usually be described by a very limited number of parameters. (4) Future investigations of molecular behavior should be directed toward more practical aspects, such as oriented and composite materials, and the relevance of basic relaxation studies to engineering matters must be carefully examined. (5) Future work should also proceed as a close collaboration between theorists and experimentalists. A.C.R.

N69-37115# Idaho Nuclear Corp., Idaho Falls.
LOW FREQUENCY VIBRATIONS IN POLYETHYLENE
W. R. Myers and P. D. Randolph *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 539–542 refs Sponsored by AEC (See N69-37063 21-08)
Avail: SOD $4.00

Measurements of the neutron scattering spectrum were extended to lower temperatures than previously achieved by obtaining absolute cross sections for the transverse and longitudinal orientations by using a MTR phased-chopper velocity selector. Data were obtained at 300°, 77°, and 4.2°K. Primary data were taken at low incident energy, which, combined with the low temperature, provided good resolution in the region of small energy transfers. The data show two commonly observed acoustic frequency limits at 25 and 65 MeV and allow better definition of some of the weaker singularities. The Debye–Waller coefficients were also measured, which are used in reducing the cross sections to the directional frequency spectra. Author

N69-37116# Michigan Univ., Ann Arbor.
NEUTRON SCATTERING IN DEUTERATED POLYETHYLENE
L. A. Feldkamp and J. S. King *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 543–548 refs Sponsored by NSF (See N69-37063 21-08)
Avail: SOD $4.00

Neutron scattering from deuterated polyethylene was studied to observe the shift in vibrational frequencies due to the deuterium mass. Features of earlier data on normal polyethylene could thereby be clarified and direct observation achieved of the dispersion relations in the predominantly coherent target. Author

N69-37118# Picatinny Arsenal, Dover, N.J.
THE VIBRATIONAL PROPERTIES OF POLYOXYMETHYLENE
S. F. Trevino and V. E. La Garde *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 553–557 refs Prepared in Cooperation with Boston Coll. (See N69-37063 21-06)
Avail: SOD $4.00

Measurements were made of the double-differential cross section for inelastic scattering of cold neutrons in order to obtain more extensive information concerning the low frequency modes, which consist of skeletal torsions and deformations. The experiment was conducted using a cold beryllium filter spectrometer in association with a 2 megawatt, light-water moderated reactor. The experimental procedure and theoretical model are described, followed by a brief discussion of the results. A.C.R.

N69-37119# Picatinny Arsenal, Dover, N.J. Explosives Lab.
VIBRATION SPECTRA OF POLYGLYCINE
V. D. Gupta, S. Trevino, and H. Boutin *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 559–565 refs (See N69-37063 21-06)
Avail: SOD $4.00

The normal modes for both in-plane and out-of-plane vibrations for polyglycine, the simplest of all synthetic polyamino acids, were recalculated and their dispersion studied, since the low frequency vibrations are expected to depend sensitively on the chain conformation. Previous normal-mode calculations only involved in-plane vibrations. Theoretical assumptions are briefly identified, and the dispersion curves, as well as calculated and observed infrared frequencies with their assignments, are included. A.C.R.

N69-37120*# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Physics.
THERMAL CONDUCTIVITY AND SPECIFIC HEAT OF AMORPHOUS POLYMERS BETWEEN 0.4 AND 4 DEGREES K
C. L. Choy, G. L. Salinger, and Y. C. Chiang *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 567–570 refs Sponsored by NASA (See N69-37063 21-06)
Avail: SOD $4.00 CSCL 07D

Due to lack of reliable thermal data for amorphous solids, measurements were made on amorphous polymethyl methacrylate, polystyrene, and polyvinyl acetate. At low temperatures where the wavelength of the dominant thermal vibrations is long compared to the microscopic disorder, it was assumed that the theory applicable to the crystalline thermal properties should also apply to amorphous solids. Data show that the thermal conductivity is qualitatively similar for all three polymers, is nearly temperature-independent near 4°K, and decreases with increasing power of temperature as the temperature is lowered. Near 4°K, no agreement with the linear temperature dependence of thermal conductivity as predicted by Klemens was found, but measurements were within five percent of the values predicted by Reese for polystyrene and commercial polymethyl methacrylate. This demonstrates that thermal conductivity is an intrinsic property of the particular polymer and depends only slightly on impurities in this temperature range. A.C.R.

N69-37135# University Coll. of North Wales, Bangor. Dept. of Chemistry.
SUB-MILLIMETER WAVE GENERATION AND SPECTROSCOPY Final Scientific Report, 1 Feb.–31 Dec. 1968
John Sheridan 31 Mar. 1969 12 p refs
(Grant AF-EOAR-67-39)
(AD-689285; AFOSR-69-1313TR) Avail: CFSTI CSCL 7/4

The use of Froome-generators as swept harmonic sources for high resolution microwave spectroscopy has been shown to be practicable. Comparative tests in conjunction with conventional methods have been initiated. Spectra at wavelengths down to less than 1 m.m. have been measured for several substances, and new molecular information obtained. Author (TAB)

N69-37155# Aerojet-General Corp., Los Angeles, Calif. Space Div.
ARACHNO-CARBORANES, ARACHNO-BORANES AND THE CARBONIUM IONS C3H7/(PLUS) AND C4H7 (PLUS): NUCLEAR MAGNETIC RESONANCE ANOMALIES
Robert E. Williams Apr. 1969 39 p refs
(Contract Nonr-4381(00))
(AD-689380; TR-17) Avail: CFSTI CSCL 7/4

Two sets of hypotheses are presented. The first accounts for the carbon locations among the various position isomers of the carboranes, while the second attempts to cross-correlate most, perhaps all, of the 11B nmr ambiguities thus far reported on the basis of tautomerism involving specific structural elements in selected nido-boranes and all of the arachno-boranes. When taken together the two sets of hypotheses allow us to predict the most probable carbon position isomers among undiscovered and structurally unresolved carboranes and, fulfilling the primary objective of this study, reassures us that major ambiguities should not be anticipated in the spectra of all carboranes which contain two or more carbons. In selected cases the hypotheses can be extended to non-boron containing compounds. Norbornyl cation, for example, has been suggested to have the structure of an arachno-carborane; it possesses the specific structural feature necessary to generate nmr ambiguities, and, indeed, it generates exactly the spectrum for such a tautomerizing system. Author (TAB)

N69-37169# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRODUCTION OF OXYGEN IN HIGH PRESSURE UNITS
D. L. Glizmanenko 3 Feb. 1969 58 p refs Transl. into ENGLISH from the book "Poluchaniye Kisloroda" Moscow, Izd. Khimiya, 1965 p 590–637
(AD-688071; FTD-HT-23-854-68) Avail: CFSTI CSCL 7/1

This report presents fundamentals of oxygen production and information on auxiliary materials. It describes the equipment, apparatus, and processes in the production of oxygen from air, and the means and methods for production control and accident prevention. Included are diagrams and technical characteristics of the latest equipment used in the production of oxygen, nitrogen, and rare gases. TAB

N69-37175# Dayton Univ., Ohio. Dept. of Physics.
THE ZEEMAN SPECTRA OF GADOLINIUM IN CALCIUM FLUORIDE AT CUBIC SITES
John A. Detrio Wright-Patterson AFB, Ohio AFML May 1969 38 p refs
(Contract AF 33(615)-3793)
(AD-689401; UDRI-TR-69-02; AFML-TR-69-43) Avail: CFSTI CSCL 7/4

The octet S7/2 ground state Gd3+ is split only 0.149/cm by the cubic crystal field in CaF2 and is described at 11.3 kG by the projection quantum number J sub Z referred to the magnetic field axis and behaves like a spin 7/2 system with an isotropic

g value of 1.991. The excited states are most conveniently described with reference to the 4-fold axes. The calculation of the dependence of the Zeeman spectra of GdG+ in CaF2 at sites of cubic symmetry on crystal orientation, therefore, requires transformation of one set of basis to a common Cartesian reference frame. The Zeeman spectra shows the states of the crystal field split hextet P(7/2) and hextet P(5/2) multiplets. The transitions are magnetic dipole in agreement with the results for other rare earth ions at cubic sites. Experimental and calculated splittings are compared. Author (TAB)

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N69-36003*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH AND ADVANCED DEVELOPMENT. VOLUME 3: SUPPORTING RESEARCH AND TECHNOLOGY FOR THE OFFICE OF TRACKING AND DATA ACQUISITION
Semiannual Review, 1 Jul. - 31 Dec. 1967
31 Jan. 1968 44 p refs
(Contract NAS7-100)
(NASA-CR-105433; JPL-701-6-Vol-3) Copyright. Avail: CFSTI CSCL 17B

Presented are techniques, designs, and development systems for tracking and data acquisition for spacecraft. The major objectives are to provide useful and error free means by which ground to space communications may take place. Through use of mathematical models and statistical reasoning, tools are developed to determine effects of solar system geometry and physics on deep space communication networks. Also included are radio frequency propagation, low noise for spacecraft receivers, temperature stabilization, solid state transmitters, low data rate telemetry systems, and data compression techniques. E.H.W.

N69-36067# Joint Publications Research Service, Washington, D.C.
BEHAVIOR OF A GROUP OF AUTOMATA IN THE PROBLEM OF POWER REGULATION
V. L. Stefanyuk *In its* Soviet Cybernetics 11 Jul. 1969 p 1-15 refs (See N69-36066 21-04)
Avail: CFSTI

Organizational problems involving the operation of a group of radio stations which generate mutual disturbances are analyzed and extensions made to an earlier theory on power egulation under such circumstances. A mathematical model based on this theory is formulated in terms of power and signal-to-noise ratios for each pair of stations. Limitations on the possible sets of signal-to-noise ratios assumed from the model were investigated. In addition, the design of power-regulating automata that comprise the group are considered. Particular attention is given to stability problems. Finally, an attempt is made to study the statistical nature of the signals and noises; this leads to operational analysis of a group of automata in the presence of a delay. A.C.R.

N69-36094# Weapons Research Establishment, Adelaide (Australia).
EFFECT OF BANDWIDTH AND CENTRE FREQUENCY ON THE THRESHOLD BEHAVIOUR OF A PULSE AVERAGING DISCRIMINATOR
P. M. Roberts and M. S. Stevens Apr. 1969 30 p refs
(WRE-TN-PAD-164) Avail: CFSTI

This paper presents the results of some experiments to determine the threshold behavior of a pulse averaging discriminator as a function of frequency and bandwidth. The measurements show that for large ratios of carrier bandwidth to center frequency the threshold signal to noise ratio increases very sharply from a minimum at midband to a high value at the lower band edge. The mechanism causing threshold is discussed. Author

N69-36096# Weapons Research Establishment, Adelaide (Australia).
SATURATION AND FOCUSSING EFFECTS IN RADIO-STAR AND SATELLITE SCINTILLATIONS
D. G. Singleton Mar. 1969 34 p refs
(WRE-TN-APD-15) Avail: CFSTI

The diffraction and refraction theories of radio-star and satellite scintillations are re-examined and successfully reconciled to produce a composite result. This result gives new emphasis to the importance of focussing and saturation effects in scintillation studies. The result is displayed as contours of equal scintillation index on a plot of the distance parameter versus the r.m.s. phase deviation produced by irregularities. In terms of this approximation, connections between a number of variables, which determine whether or not irregularities fall into the saturation and focussing regimes, are examined. These variables include electron density increment in the irregularities, their size and shape, azimuth and topocentric and magnetic zenith angles of the direction of propagation, observing frequency and geomagnetic latitude of the point of observation. Author

N69-36215*# Houston Univ., Tex. Cullen College of Engineering.
TERRAIN BIAS ON DOPPLER SYSTEM OUTPUT
H. S. Hayre [1969] 4 p
(Contract NAS9-6760)
(NASA-CR-101804; TR-68-6) Avail: CFSTI CSCL 17I

Statistically random rough surfaces cause a spread of their Doppler spectrum obtained by a transmit-receive system. This is shown to hold both theoretically as well as experimentally. An X-band radar system flight data and its ultrasonic simulation data constitute the experimental effort. A thorough and complex random variable transformation solution yields a normal distribution for such a Doppler signal after mixing and passing it through a low pass filter. This is also verified by experimental data. Author

N69-36285*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO 6, 7, AND 8 BLACKOUT TEST RESULTS
John W. Marini and Frederick W. Hagar (Bendix Corp., Detroit, Mich.) Jul. 1969 32 p refs Prepared by Bendix Corp., Detroit, Mich. for NASA
(Contract NAS5-10750)
(NASA-TM-X-63636; X-550-69-277) Avail: CFSTI CSCL 17B

S-band communication blackout measurements made during the reentry phases of the Apollo 6, 7, and 8 missions are presented. The occurrence of blackout as a function of the altitude and speed

of the reentering Apollo Command Module are compared with a theoretical curve. The agreement is good at the high speed end of the curve, but poor for the one point available at the low speed end. Author

N69-36262*# Techtran Corp., Glen Burnie, Md.
SPECIAL FEATURES OF THE TRANSMISSION SYSTEMS OF THE SATELLITE ESRO 2/IRIS
J. Toussaint [1969] 33 p Transl. into ENGLISH from ESRO/ELDO Bull. (France), 2 Aug. 1968 p 13–24 *Its* No. 33
(Contract NAS5-14826)
(NASA-CR-105626) Avail: CFSTI CSCL 17B

In this pamphlet devoted to the ESRO satellite IRIS, it appeared advantageous to include an article describing the special features of the transmission systems by means of which the stations of the ESRO network keep permanent contact with the satellite once in orbit. Discussion will first center on the telemetry system used by the satellite to transmit to the ground the result of its observations and then describe the commanding guidance system whereby the satellite receives and executes the guidance control commands required by the mission. Author

N69-36382# RAND Corp., Santa Monica, Calif.
CENTRAL LIMIT THEOREMS FOR CONDITIONALLY LINEAR RANDOM PROCESSES WITH APPLICATIONS TO MODELS OF RADAR CLUTTER
Percy A. Pierre Apr. 1969 51 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-688213; RM-6013-PR) Avail: CFSTI CSCL 17/9

The paper presents models of random processes which have been found useful as models of radar clutter and reverberation interferences. A widely applicable technique for finding criteria under which linear processing of data (correlator outputs) will produce Gaussian statistics is presented. The models are called conditionally linear processes, and the description of the correlator output requires a central limit theorem for sums of dependent random variables. The conditions for the central limit theorem are related to physically reasonable conditions on the model. The results of the study are relevant to radar-interference problems and to the processing of non-Gaussian statistical data. TAB

N69-36410*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND DATA SYSTEM SUPPORT FOR THE MARINER VENUS 67 MISSION: PLANNING PHASE THROUGH MIDCOURSE MANEUVER
N. A. Renzetti 1 Sep. 1969 223 p
(Contract NAS7-100)
(NASA-CR-105635; JPL-TM-33-385-VOL-1) Avail: CFSTI CSCL 17G

The technical activities of the Tracking and Data Acquisition facilities of the Air Force Eastern Test Range, the Manned Space Flight Network of Goddard Space Flight Center, and the Deep Space Network of JPL in support of the *Mariner* Venus 67 Mission, covering the period from the establishment of the requirements between the Project and the Tracking and Data System through the execution of the midcourse trajectory in flight are summarized. The report delineates the following: the metric, telemetry, and command requirements placed on the network; the equipment configuration needed to carry out the functions; the ground communications system configuration required to transmit data from Cape Kennedy and the Deep Space Stations to JPL, California; and the equipment configuration in the Space Flight Operations Facility necessary for the reception, processing, and display of data to support the conduct of flight operations. A table summarizes the deep space phase flight support afforded this mission and data related to the performance of the networks. Author

N69-36490*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR 7 TELEVISION DATA PACKAGE, 1968
1968 131 p
(Contract NAS7-100)
(NASA-CR-105728) Avail: CFSTI CSCL 17B

The Surveyor 7 television data that have been compiled to date are presented to assist in the scientific analysis of the data. The information is arranged under the following topics: calibration, operations information, image data description, and television identification data description. Tables and charts summarizing results are included. F.O.S.

N69-36531 World Meteorological Organization, Geneva (Switzerland).
GLOBAL TELECOMMUNICATION SYSTEM: METHODS AND EQUIPMENT FOR AUTOMATIC DISTRIBUTION OF INFORMATION
1968 63 p *Its* World Weather Watch Planning Rept. No. 24
Copyright. Avail: Issuing Activity

Several WMO meetings have stressed the urgent need for studies to assist in working out the details of the Global Telecommunication System (GTS) and to provide the countries concerned with specifications which would ensure compatibility of equipment and methods of operation of circuits and centers. The procedures for the addressing and distribution of messages and bulletins in the GTS are discussed taking into account the latest techniques, equipment and message-switching methods. Views are expressed on suggestions for new addressing schemes operated in conjunction with a set of priorities for message routing and recognition. Questions concerning the contents and format of bulletins as well as organizational procedures for the distribution of information are also dealt with. Descriptions are given of automatic data-distribution systems for observational and processed information, together with detailed technical specifications for the equipment needed at various types of centers. The functions of systems editing, selection, signal regeneration and switching are discussed. Author (ESRO)

N69-36580*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LUNAR ROCKET RESCUE BEACON
Lee B. Malone, Jr. *In its* Res. Achievements Rev., vol. 3, 1968 p 21–41 refs (See N69-36577 21-17)
Avail: CFSTI CSCL 17B

The results of a feasibility investigation for an emergency relay communications system between a lunar module (LM) and an extra vehicular astronaut (EVA) are presented. The proposed system uses a small, hand launched rocket containing a miniaturized tran'ceiver. This communications relay is injected between existing Apollo communications equipment in the LM and the astronaut's back-pack. This paper shows that it is feasible to provide a short range, light weight, voice relay communications system between the LM and EVA for periods up to 200 seconds. Author

N69-36642# Federal Aviation Administration, Atlantic City, N.J. National Aviation Facilities Experimental Center.
EXPERIMENTATION AND ANALYSIS OF SITING CRITERIA Final Report
George F. Spingler Sep. 1969 148 p
(NA-69-36; RD-69-43) Avail: CFSTI

Criteria for siting future radar beacons and minimizing reflection problems at existing sites were developed. Reflection study calculations were made to determine the intensity of signals reflected from a standard flat plate. From these computations, nomographs were developed which predicted the maximum range of a reflection

and the signal intensity at various ranges from the reflector. At the completion of the reflection study, a number of tests, with practical propagation models, were performed to confirm the theory. The results of the tests showed that the improved 3-pulse side lobe suppression system effectively reduced reflected replies, provided the reflecting surface was at least 750 feet from the directional antenna. Reflected replies were also reduced appreciably when the signals from the reflector were made to impinge on the surface of the terrain, adjacent to the reflector, at the Brewster angle of the particular type of terrain. Author

09 COMPUTERS

N69-36856*# Techtran Corp., Glen Burnie, Md.
FREQUENCY SPECTRUM OF COSMIC RADIO EMISSION IN THE FREQUENCY RANGE OF 10-207 MHz AT HIGH GALACTIC LATITUDES
G. G. Getmantsev et al 1968 18 p refs Transl. into ENGLISH from Izv. Vyssh. Uchab. Zaved., Radio Fiz. (Gor'kiy), v. 11, no. 2, 1968 p 191–199
(Contract NAS5-14826)
(NASA-CR-105622) Avail: CFSTI CSCL 17B

Described are antennas, apparatus, and techniques for measuring the frequency spectrum in the frequency range of 40-207 MHz. The measurements place the average spectral index of radio emission $\alpha = 0.57 \pm 0.04$ in the frequency range of 40-207 MHz. A comparison of the results with the those of other authors indicate that as the frequency increases from 10 to 207 MHz, the spectral index of distributed cosmic radio emission at high galactic latitudes changes relatively little. Author

N69-36696# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.
THEORY AND PERFORMANCE OF BINARY FM SYSTEMS IN A RESTRICTED BAND
Tjeng Thiang Tjhung Apr. 1969 159 p refs
(Contract DRB-CD-813011; Grant NRC A-3391)
(RR-69-2) Avail: CFSTI

The desirability of digital FM systems was investigated in terms of the probability of bit error. The FM receiver considered, consists of a predetection filter, a limiter-discriminator, and a post-detection filter. Results are presented on the effect of predetection bandwidth restriction on the error performance of binary FM systems for various frequency deviations. Theoretical results were obtained by a Fourier analysis of the distorted FM signals and by Rice's click analysis of FM noise. The data presented permits selection of an optimum set of system parameters such as the frequency deviation ratio and I.F. bandwidth. It is found that in narrow band operation, a peak-to-peak frequency deviation of about 0.7 times the bit rate and an I.F. bandwidth of about 1.0 times the bit rate should be chosen to obtain optimum performance. Author

N69-36783*# Stanford Univ., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semiannual Status Report, 1 Jan. – 30 Jun. 1969
V. R. Eshleman Jul. 1969 20 p refs
(Grant NGL-05-020-014; SEL Proj. 3208)
(NASA-CR-105533; SASR-13) Avail: CFSTI CSCL 17I

The reduction and analysis of the bistatic-radar data from Explorer 35 is discussed. The principal block of data from the observations was completed. Current efforts in data reduction are directed toward obtaining very high quality bistatic-radar spectra, representative of various portions of the lunar surface, from the Arecibo observations. Author

N69-36832# Royal Aircraft Establishment, Farnborough (England).
REFLECTING AND DISC ANTENNAS FOR DECIMETRE WAVES [REFLEX UND LEITSCHEIBEN-ANTENNEN FUER DEZIMETERWELLEN]
G. v. Trentini Jun. 1969 24 p refs Transl. into ENGLISH from NTZ-Nachrtech. F. (Brunswick), v. 8, no. 11, Nov. 1955 p 569–577
(RAE-LIB-TRANS-1386) Avail: CFSTI

New versions of beam antennas for decimeter waves are described and investigated. These consist of a dipole with reflecting screen and simple metal surfaces installed in front of it. The radiation in the main direction is increased by reflection and diffraction. A half power beam width of 40° to 25° and a gain of 12 to 16 db can be obtained from practically usable arrangements. The parasitic disc antennas have a higher gain than reflex antennas of comparable dimensions, but side lobes are stronger. The directivity can be increased by composite systems or the radiation of energy may be split into several selected directions. Author

N69-36888*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MULTIPLE-ACCESS SATELLITE RELAY SYSTEM FOR LOW DATA RATE USERS
P. J. Hefferman and C. E. Gilchriest (JPL - Pasadena, Calif.) Aug. 1969 11 p refs Reprinted Presented at the Western Electron. Show and Conv., San Francisco, Aug. 1969
(NASA-TM-X-63660; X-733-69-385) Avail: CFSTI CSCL 17B

Presented is a preliminary design concept for a typical broad-beam TDRS implementation using synchronous relays to support multiple manned and automated low-orbiting spacecraft in the conventional VHF bands. Spread-spectrum signalling techniques are employed to provide common-channel multiple-access and to combat multipath and RFI from earth-based sources. System performance is presented in parametric form in terms of system loading and the relative severity of multipath and RFI signals. Antenna and transponder requirements for both synchronous relay and user spacecraft are discussed along with possible alternative implementations. Problem areas include compatibility with existing frequency allocations and usage, antenna design for small unstabilized user spacecraft, synchronization, and relay-to-relay handover procedures. Author

N69-36945 Princeton Univ., N.J.
SOME REPRESENTATION PROBLEMS IN SIGNAL THEORY
Elias Masry (Ph.D. Thesis) 1968 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-2764

A number of problems in communication theory, whose solutions rest upon the closure of appropriately defined sets of functions in L^2, are investigated. Two Banach spaces Σ and $\sum_a$ of bounded linear shift invariant operators are defined on L^2 and l^2 respectively. A general approach to the derivation of series expansions of second order, wide-sense stationary, mean-square continuous random process, valid over an infinite-time interval, is presented. The coefficients of the expansion are orthogonal and convergence is in the mean square sense. The derivation covers both the periodic and the aperiodic cases. A constructive procedure is presented to obtain an explicit expansion for a given spectral distribution. The problem of exact reconstruction of the spectral density function of a wide-sense stationary random process from its samples is considered. Random sampling by a stationary point process, for which the intervals between successive sampling points are independent and identically distributed, can be found to eliminate aliasing. The discussion is directed mainly toward the generation of stationary point process having dependent sampling intervals that yield alias free sampling. It is shown for a wide class of sampling schemes that the alias free characteristic is inverient under independent random delation of samples. Dissert. Abstr.

N69-36984*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BLOCK-CODED COMMUNICATIONS
William C. Lindsey 15 Aug. 1969 21 p refs
(Contract NAS7-100)
(NASA-CR-105796; JPL-TR-32-1380) Avail: CFSTI CSCL 07B

A theory for use in the design of block-coded telemetry systems is delineated. This theory is useful in designing and testing the performance of one- and two-way, phase-coherent telemetry systems when a double-conversion, superheterodyne, phase-locked receiver preceded by a band pass limiter is used to track the carrier. System analysis for either orthogonal or bi-orthogonal codes is given. Design trends, relating the various system parameters, are presented in graphical form for practical code sizes. Emphasis is placed on the case of greatest practical interest: the design situation in which the data rate is large when compared to the design point bandwidth of the carrier tracking loop. Author

N69-36987*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
ATTENTUATION OF MILLIMETER AND SUBMILLIMETER RADIO WAVES IN RAINS [OB OSLABLENII MILLIMETROVYKH I SUBMILLIMETROVYKH RADIOVOLN V DOZHDYAKH]
A. P. Naumov and V. S. Stankevich Washington NASA Sep. 1969 5 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Radiofiz. (Gor'kiy), v. 12, no. 2, 1969 p 181–184
(Contract NASw-1692)
(NASA-TT-F-12575) Avail: CFSTI CSCL 17B

The attentuation coefficient of radio waves is calculated in the 0.5 to 3-mm range during rains of different intensities (0.25 to 150 mm/hr). It is shown that the attentuation coefficient, in the wavelength range considered, varies from 0.4 db/km for a slight drizzle to 50 db/km for a tropical shower. A table is given illustrating the effective loss cross section Q(cm^2) as a function of raindrop diameter and wavelength. Author

N69-36999*# Texas Instruments, Inc., Dallas.
STUDY OF SOLID-STATE INTEGRATED MICROWAVE CIRCUITS Final Report
Jan. 1969 41 p
(Contract NAS 12-75)
(NASA-CR-86210; U40-811500-40; SR-7) CSCL 17B

The final design activity and test results on a microwave FM telemetry receiver and a microwave FM telemetry transmitter are discussed. The transmitter and receiver are presented in separate sections. Circuit analysis and design of individual blocks within the basic units are presented, as well as individual and final test results. Author

N69-37011# Air Force Cambridge Research Labs., Bedford, Mass.
WIDEBAND SCATTERING FROM RANDOMLY DISPERSED DISCONTINUITIES IN A TRANSMISSION LINE: STATISTICAL THEORY Interim Report
Walter Rotman Feb. 1969 57 p refs *Its* Phys. Sci. Res. Papers No. 370
(AD-688217; AFCRL-69-0064) Avail: CFSTI CSCL 9/1

In a theoretical treatment of the effects of signal bandwidth on the characteristics of electromagnetic waves reflected from randomly dispersed scatterers, a simplified one-dimensional model consisting of a transmission line with randomly spaced discontinuities is analyzed by methods of statistical communications and scattering theory. The probability density function (PDF) for the power reflection coefficient in this line is derived analytically for input signals composed of either discrete or continuous frequency spectra. The analysis shows that statistical fluctuations in the reflected power decrease with increasing bandwidth. An algorithm allows substituting a spectrum composed of equispaced, discrete frequencies for a continuous, band-limited spectrum in the analysis. The effects of interaction between the scatterers and of resistive attenuation in the transmission line are also considered quantitatively. The application of these results to three-dimensional scattering problems, such as microwave propagation in the troposphere or optical scattering from random particles, is discussed briefly. Techniques for extending the theory to physical situations that involve temporal and spatial, as well as spectral, variations of the scattered energy are included. Author (TAB)

N69-37121# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ECHO REMOVAL BY DISCRETE GENERALIZED LINEAR FILTERING
Ronald W. Schafer (Ph.D. Thesis) 28 Feb. 1969 133 p refs
(Contract DA-28-043-AMC-02536(E))
(AD-688195; TR-466) Avail: CFSTI CSCL 9/4

A new approach to separating convolved signals, referred to as homomorphic deconvolution, is presented. The class of systems considered in this report is a member of a larger class called homomorphic systems, which are characterized by a generalized principle of superposition that is analogous to the principle of superposition for linear systems. A detailed analysis based on the z-transform is given for discrete-time systems of this class. The realization of such systems using a digital computer is also discussed in detail. Such computational realizations are made possible through the application of high-speed Fourier analysis techniques. As a particular example, the method is applied to the separation of the components of a convolution in which one of the components is an impulse train. This class of signals is representative of many interesting signal-analysis and signal-processing problems such as speech analysis and echo removal and detection. It is shown that homomorphic deconvolution is a useful approach to either removal or detection of echoes. Author (TAB)

N69-37188# Cutler-Hammer, Inc., Melville, N.Y. Airborne Instrument Lab.
HIGH CIRCUIT Q'S WITH NIOBIUM STANNIDE AT RADIO FREQUENCIES
Kenneth Siegel, R. Domchick, and F. R. Arams *In* Va. Univ. Phys. of Superconducting Devices 1967 10 p refs Supported by Army Electron. Command (See N69-37176 21-09)
Avail: CFSTI

A simple refrigerated radio frequency preselector to reduce interference in radio communications was investigated. Niobium stannide with its high transition temperature was studied as a cooling agent in a small closed cycle refrigerator. Open cycle and small closed cycle refrigerators are discussed in detail. J.A.M.

N69-37200# Information Research Associates, Inc., Waltham, Mass.
SPEAKER DISCRIMINATION USING WIENER CANONICAL FORMS
Ernest G. Henrichon, Jr. Jan. 1969 48 p refs
(Contracts AF 49(638)-1631; F19628-67-C-0329)
(AD-689282; TR-18; IRA-122.7, IRA-102.20; AFOSR-69-1515TR)
Avail: CFSTI CSCL 17/2

Presented in this report are the results of one experiment conducted in our overall effort aimed at determining the applicability of the Wiener Canonical Expansion (WCE) in distinguishing classes of real stochastic waveforms. The two classes of waveforms selected were the time speech waveforms from two different speakers. No special consideration was given to the fact that these sample waveforms represented speech. Three separate experiments consisting

of voiced sounds, unvoiced sounds and regular speech were conducted. The tentative result of this investigation is that over the range of Laguerre time scaling coefficients used, speaker identification cannot be accomplished with any degree of certainty by treating a speaker waveform as a sample from a stationary (or quasi-stationary) random process. The necessary theoretical background, the experimental setup and the results on which this conclusion is based form the body of this report. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N69-36087# Sandia Corp., Albuquerque, N. Mex.
SMALL COMPUTER MASTER-SLAVE OPERATIONS VIA VOICE GRADE TELEPHONE LINES
John Marcon, Jr., John R. Rosboborough, and Louis O. Cropp Feb. 1969 45 p refs Sponsored by AEC
(PB-183547; SC-DC-69-1654) Avail: CFSTI CSCL 09B

The PDP8 family of computers, data sets, and an inexpensive interface were combined with a moderate amount of software to provide the small computer user with an extremely reliable and flexible means to control remotely located computers with computers of the same family. Using this system, any desired master-slave operation can be achieved. This system can be easily adapted to families of computers other than the PDP8. Author (USGRDR)

N69-36115 Princeton Univ., N.J.
NONLINEAR PROGRAMMING APPLIED TO CONTROL PROBLEMS
John V. Flynn, Jr. (Ph.D. Thesis) 1968 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-2536

Mathematical programming, in the form of nonlinear programming, is examined as an approach to solve the general optimal control problem. It is shown that this approach of converting the optimal control problem into a mathematical programming problem is a feasible and viable method, and that it has many advantages over alternate methods of solving the control problem. It is shown that the approach can be used to solve a variety of problems in addition to the general control problem, including delay problems, filtering problems, and estimation problems. Two powerful nonlinear programming algorithms are examined, and it is shown that the conjugate gradient algorithm is more efficient than the gradient projection method. It is concluded that the conjugate gradient algorithm is one of the most powerful methods available for solving control problems as well as the other types of problems mentioned. Dissert. Abstr.

N69-36138 Wisconsin Univ., Madison.
STUDIES IN PROCESS ENGINEERING
Anthony Halim Masso (Ph.D. Thesis) 1968 260 p
Avail: Univ. Microfilms: HC $11.70/Microfilm $3.35 Order No. 68-14010

The problem of system synthesis is discussed, and the use of a heuristic structuring strategy in the development of computer programs for the synthesis of process design is examined. By the employment of selection weights which are adjusted as experience is gained from past successes and failures, the computer is able to learn the sequence of structuring decisions which lead toward the optimal process design. The computer can develop competence in the synthesis of systems in a limited area of technology. The mechanized structuring of heat exchanger networks is offered in illustration of the proposed method. Initial results from work in the area of system safety are also reported. The spread of violence through weakly connected systems by a probabilistic mechanism is studied. Probability theory and Monte Carlo simulation are used to develop preliminary criteria for the safe design of storage systems through which disaster may spread by random series of detonations. Parametric results are qualitatively compared with those given by data suggested for the specification of explosives storage. Likewise, the basic postulates employed are checked against limited experimental conclusions. Dissert. Abstr.

N69-36148# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
THE INTERFACE OF COMPUTER SCIENCE AND STATISTICS
Arnold F. Goodman Aug. 1969 32 p refs
(Douglas-Paper-5204) Avail: CFSTI

A structure for the interface is introduced initially, followed by an historical background for the interface presented in two parts. First to be summarized is the evolution of the interface from an interweaving of the mechanical prerequisites to the computer and mathematical prerequisites to computer science and of the foundations for probability and statistics. Development of statistics prior to 1900 then is reviewed. Author

N69-36281*# Stanford Univ., Calif. Radioscience Lab.
ENTROPY OF PRINTED MATTER AT THE THRESHOLD OF LEGIBILITY FOR EFFICIENT CODING IN DIGITAL IMAGE-PROCESSING
Ronald Barthold Arps Jun. 1969 114 p refs
(Grant NGL-05-020-014)
(NASA-CR-105647; SU-SEL-68-102; SR-31) Avail: CFSTI CSCL 09B

Printed matter as a two-dimensional, two-valued, stochastic process, is studied to determine how its statistical properties vary with resolution. The tradeoff between document quality and document entropy is explored by taking each factor separately and modeling its dependence on spatial frequency. Since these factors really depend on the ratio between resolution and character size, all results are reported in terms of normalized spatial frequency. Stroke width is used to express character size in this normalization. Legibility of characters, out-of-context, is used as the document quality measure for printed matter. A piece-wise linear model for the dependence of legibility on resolution is postulated, based on concepts from the sampling theorem. An empirical model is also fitted to the data, as it varies over combinations of two-dimensional resolution. Author

N69-36286*# National Aeronautics and Space Administration, Washington, D.C.
DIGITAL DATA RETRIEVAL FACILITY FOR A BLOW-DOWN SUPERSONIC WIND TUNNEL [DIGITALE DATENERFASSUNGSANLAGE FUER EINEN BLOW-DOWN-UEBERSCHALLKANAL]
A. Heyser et al Sep. 1969 12 p refs Transl. into ENGLISH from WGLR Report, May 1968 p 147–162
(NASA-TT-F-11506) Avail: CFSTI CSCL 09B

Construction and performance of a digital data acquisition system for use with supersonic wind tunnels is described. The system includes 11 measuring channels and is able to pick up about 200 measurements per second. Collected are power, static pressure, static temperature, normal pressure, ground pressure, and angle of attack measurements during tests. Data are then transferred onto punch tape for automatic readout. Author

N69-36319*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
FORMATION OF THE PRINCIPAL TYPES OF GAS-TURBINE ENGINES
Yu. S. Voronkov *In its* Trans. of the Tenth Sci. Conf. of The Inst. of Hist. of Nat. Sci. and Tech. Sep. 1969 p 40–48 refs (See N69-36314 21-34)
Avail: CFSTI CSCL 21E

The author presents the formation of the principal types of gas turbine engines (GTE's) in the form of a damped-oscillation process. It is shown that the beginning of this process preceded the appearance of the first models of GTE's. Innovations and new ideas were often the results of tests with the models, and not analyses of the principles on which the models were based. The end of the process came at the beginning of the 1950's, when all the main types of sonic GTE's had been successfully completed. Author

N69-36437*# Marquardt Corp., Van Nuys, Calif.
LINE SKIP COMMUTATOR FOR A SOLID STATE CELESTIAL FIELD SCANNER
W. H. Hall, J. M. Hanlet, and R. W. Haas Feb. 1969 58 p
(Contract NAS12-521)
(NASA-CR-86222) Avail: CFSTI CSCL 09B

The feasibility of fabricating a line skip commutator in a thin film configuration suitable as a readout device for the Marquardt Ferrotron image sensor plate in celestial field scanner applications was demonstrated. A logic study provided a configuration that permits readout by line skip commutation rather than sequential scanning of an image plate and eliminates the possibility of ambiguity in a matrix readout. A hybrid thin film configuration of the commutator was fabricated and tested thus confirming feasibility of operation. A development program in the use of ion implantation techniques for the fabrication of active thin film switching elements was initiated. Author

N69-36535*# International Business Machines Corp., Yorktown Heights, N.Y. Watson Research Center.
A FORMAL THEORY OF CUBICAL COMPLEXES Final Report
J. Paul Roth, Eric G. Wagner, Marvin Perlman, and Leon S. Levy Pasadena, Calif. SPL 31 Aug. 1968 243 p refs Prepared jointly by JPL and IBM
(Contracts NAS7-100; JPL-952341; JPL-951538)
(NASA-CR-105604) Avail: CFSTI CSCL 09B

The logic minimization problem, an updated version of the extraction algorithm, and a user's description of the IBM 7094 program MIN6 are presented. A writeup of a multiple-output extraction is given and the notion of singular cube and singular complex is introduced with a new algorithm notation. A general axiomatic treatment of the extraction algorithm is given for the minimization of logical circuits. A description of a very abstract and axiomatic treatment of the switching theory, and an APL-implementation of the 2-level MOM program are included. Author

N69-36581*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BUFFER FULLNESS CONTROLS FOR A DATA COMPRESSOR USING SATURN VEHICLE DATA
Gabriel R. Wallace *In its* Res. Achievements Rev., Vol. 3, 1968 p 43–54 refs (See N69-36577 21-17)
Avail: CFSTI CSCL 09B

The results of experimental studies of buffer fullness in a zero order, fixed corridor, nonredundant sample transmitted data compressor are presented. Although this study is continuing, some results are now evident. The buffer fullness is monitored while various methods of control are tried. The data fed into the data compressor were recovered from Saturn flights. Important factors of buffer fullness control are the input data, output rate, allowable data compressor time delay, and allowable information loss. For nonstationary ensembles (such as the Saturn data sources) with large variations in data compressibility, some method of rate control seems to be indicated. For an ensemble of data sources exhibiting relatively high compressibility and low variations, tolerance control of buffer fullness seems possible. Author

N69-36637# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
COMPUTER PROGRAM ORGANIZATION INDUCED BY PROBLEM EXAMPLES
Donald S. Williams (Ph.D. Thesis) May 1969 152 p refs
(Contract F44620-67-C-0058; Grant PHS-MH-07722)
(AD-688242; AFOSR-69-1308TR) Copyright. Avail: CFSTI CSCL 9/2

Interests in the fields of induction and problem solving are combined in a program called the Aptitude Test Taker, which forms a conceptualization from worked examples of an inductive reasoning task and organizes a computer program to perform the task. The development of the Aptitude Test Taker was influenced both by computer models of human performance and artificial intelligence research. The evolution of the Aptitude Test Taker was guided by detailed human performance data. The Aptitude Test Taker is a knowledgeable conceptualizer using feature extraction to induct a performance strategy. Unlike earlier attempts at developing a performance strategy from worked examples of the task, the Aptitude Test Taker uses a parsimonious set of examples rather than requiring examples of every situation that will be encountered. The performance of the Aptitude Test Taker, on tasks within its capability, parallels human performance and exceeds the performance of the other computer programs that can deal with one or more of the tasks. Other programs that solve similar reasoning tasks do not induct a performance strategy from examples. Author (TAB)

N69-36640*# Ohio State Univ., Research Foundation, Columbus. Dept. of Geodetic Science.
DATA ANALYSIS IN CONNECTION WITH THE NATIONAL GEODETIC SATELLITE PROGRAM (II) Semiannual Status Report, Feb.–Jul. 1969
Aug. 1969 32 p refs
(Grant NGR-36-008-093; Proj. Osurf No. 2514)
(NASA-CR-105615; SASR-4) Avail: CFSTI CSCL 09B

Data accumulated by the GEOS 1 satellite are analyzed to perform simultaneous network adjustments. The information pertaining to these adjustments and the final adjusted geodetic coordinates of the network tracking stations are tabulated. It is proposed that the study of range difference adjustment continue until a conclusion can be reached as to the minimum number of ground stations needed for the range difference model using both geometric and short-arc modes. The conversion of existing computer programs is discussed. F.O.S.

N69-36641# Institute for Perception RVO-TNO, Soesterberg (Netherland).
ON THE INTERNAL REPRESENTATION OF ASSOCIATIVE DATA NETWORKS
John A. Michon [1968] 35 p refs Sponsored by NATO
(IZF-1968-12; TDCK-51206-II) Avail: CFSTI

The concept of internal representation has acquired new significance through the information processing approach to psychology. An attempt is made to formulate the problem of investigating the elusive internal representation and to outline a

framework, in which experimental investigations may be placed. Such a frame is provided by the possibility to treat many data structures as graphs or networks. An internal representation may be considered complete to the extent that equivalent associations, whether explicitly taught or not, are retrieved with equal speed and equal probability of being correct. Two exploratory experiments illustrate a way of experimental control, in which a digital computer is employed. Rather than relying on protocol analysis for obtaining data, experimental conditions themselves should be indicative of the way storage and retrieval of information in internal representations is accomplished. Author

N69-36648# RAND Corp., Santa Monica, Calif.
DISCRETE PROGRAMMING APPLICATIONS OF TECHNIQUES FOR HANDLING A COMMON LIST STRUCTURE
B. L. Fox May 1969 27 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-688211; RM-5951-PR) Avail: CFSTI CSCL 9/2

It is pointed out how two list-handling algorithms: heapsort and balanced tree search, can accelerate incremental allocation and branch and bound algorithms--in particular certain integer programming algorithms. The use of incremental allocation and branch and bound algorithms has been important in solving diverse operations research problems arising in inventory control, redundancy optimization, target allocation, and circuit minimization. Any scheme that can make these algorithms more efficient will be of great practical significance. For the incremental allocation application, when no buffering is needed, heapsort seems preferable to handle the storage problem, and it appears that balanced tree search will be better suited for branch and bound and algorithms. Author (TAB)

N69-36654# Pennsylvania Univ., Philadelphia. Moore School of Engineering.
AN INTERACTIVE GRAPH THEORY SYSTEM
Michael S. Worlberg Jun. 1969 363 p refs
(Contract Nonr-551(40))
(AD-688931; Rept-69-25) Avail: CFSTI CSCL 9/2

The dissertation describes how a remote computer graphics terminal was connected into an existing multi-console operating system which previously supported only Teletype and alphanumeric display terminals. In this environment an Interactive Graph Theory System was built where modularity and flexibility have been stressed. The DEC-338 is used both as an alphanumeric console and a graphics terminal. The design has departed from other efforts involving a computer graphics terminal with processing power. In this system the terminal may be programmed to perform both local functions and functions which are performed as subroutines of the interactive program running in the central computer. TAB

N69-36705# Bradford Univ., (England). Postgraduate School of Electrical and Electronic Engineering.
EXACT AND APPROXIMATE INVERSE DIGITAL FILTERS
(Rept-8) Avail: CFSTI

Important high frequency information, often masked by transducer resonances, can now be resolved by "inverse" digital filters. The inverse filter, however, has the characteristic that its memory function (impulse response) increases without limit. This treatment separates a z-transformed function to an appropriate number of wavelets. Each wavelet is treated either as minimum delay or maximum delay according to whether it lies external or internal to the z-plane unit circle. Stability is thus guaranteed and the inverse filter is obtained by convolution of all the separate inverse wavelets. Author

N69-36713*# Arizona Univ., Tucson. Dept. of Electrical Engineering.
AUTOMATED GENERATION OF DISTRIBUTED-LUMPED-ACTIVE NETWORK DESIGN CHARTS BY DIGITAL COMPUTER ROOT-LOCUS TECHNIQUES
L. P. Huelsman and F. L. Watson Jul. 1969 46 p refs
(Grant NGL-03-002-136)
(NASA-CR-105759) Avail: CFSTI CSCL 09B

A method of using a digital computer root-locus program as a means for generating design charts which may be used to synthesize distributed-lumped-active networks was described. An application of the program is made to a specific network configuration in which the positions of the dominant complex conjugate poles and zeros may be chosen by the user. Design charts for this network are included. Author

N69-36744*# Pittsburgh Univ., Pa. Knowledge Availability Systems Center.
[SPECIAL EXPERIMENTAL PROJECTS INVOLVING INFORMATION SYSTEMS AND TECHNOLOGY UTILIZATION] Quarterly Report
Jul. 1969 10 p refs
(Contract NSR-39-011-076)
(NASA-CR-105754; QR-7) Avail: CFSTI CSCL 05B

The activities in special experimental projects involving information systems and technology utilization are reported. The projects discussed are: investigation of means for improving exploitation of indexes, thesaural development to permit improved relevance predictability of searches, investigation of comparative relevance of search results, and demand searches. Retrospective searches in unclassified document collection for 35 profiles were performed. The three types of services provided were: (1) a copy of the printout of the computer search, listing only the accession numbers of the documents identified; (2) a copy of the printout of the computer search, listing only the accession numbers of the documents identified, plus a copy of the abstract of each document; and (3) a listing of the accession numbers of the documents related to the profile, cited mechanically or manually, plus copies of the abstracts and copies of the abstracts of related documents. The results are tabulated. F.O.S.

N69-36834# Louisiana State Univ., Baton Rouge. Coll. of Engineering.
CONTROLLING A VERY NOISY SYSTEM Interim Technical Report
Brian L. Ramaker, Cecil L. Smith, and Paul W. Murrill Jun. 1969 26 p refs
(Contract F44620-68-C-0021; Proj. Themis)
(AD-688806; THEMIS-LUS-T-TR-16; AFOSR-69-1425TR) Avail: CFSTI CSCL 12/1

The conventional approach to feedback control does not seem to take full advantage of the digital computers capability. In fact, Lopez has shown that the analog controllers (neglecting nonidealities) are capable of superior performance over their discrete counterparts. Although this may not be the case in practice, it appears unlikely that the digital algorithm in itself offers enough improvement over its analog counterpart to justify the extra expenditure for the digital computer. A second problem with the conventional approach to feedback control lies in the tuning of the controller or algorithm parameters. Automated tuning techniques are one answer, the current approach being to relate the control settings to parameters in a model of the process. However, if a model of the process is available, then why not use it to develop a control algorithm more compatible to the process than the two- or three-mode algorithm. This article explores this kind of reasoning

by examining a control strategy for a simulated stirred-tank chemical reactor. This system will be modeled and then controlled by a control strategy determined from the model. Author (TAB)

N69-36885# Joint Publications Research Service, Washington, D.C.
PROGRESS MADE IN AUTOMATED CONTROL, DATA PROCESSING
29 Jul. 1969 45 p refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 5, 1969 p 108–136
(JPRS-48510) Avail: CFSTI

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1. FORMALIZATION AND STANDARDIZATION OF PROJECTS IN DESIGNING AUTOMATIC CONTROL SYSTEMS O. I. Aven p 1–32 refs (See N69-36886 21-08)

2. ADAPTIVE SEARCH PROCESS FOR FINDING THE DATA PROCESSING SEQUENCE L. B. Nisnevich et al p 33–43 ref (See N69-36887 21-08)

N69-36886# Joint Publications Research Service, Washington, D.C.
FORMALIZATION AND STANDARDIZATION OF PROJECTS IN DESIGNING AUTOMATIC CONTROL SYSTEMS
O. I. Aven *In its* Progr. Made in Automated Control, Data Process. 1969 p 32 refs (See N69-36885 21-08)
Avail: CFSTI

Maximum formulization in standardization of the development of automatic control systems is investigated. The utilization and output of documents which are clearly defined with respect to form and content are studied. Also included in the study are documents and their interrelations. Author

N69-36887# Joint Publications Research Service, Washington, D.C.
ADAPTIVE SEARCH PROCESS FOR FINDING THE DATA PROCESSING SEQUENCE
L. B. Nisnevich et al *In its* Progr. Made in Automated Control, Data Process. 1969 p 33–43 ref (See N69-36885 21-08)
Avail: CFSTI

Computerized data processing is investigated under the condition that the output data should be received at given but a priori unknown times. The adaptive process is presented which either leads to the data processing sequence not violating the times or indicates that such a sequence does not exist. Author

N69-36894# Massachusetts Inst. of Tech., Cambridge.
A FORMAL SYSTEM FOR DEFINING THE SYNTAX AND SEMANTICS OF COMPUTER LANGUAGES
Henry F. Ledgard (Ph.D. Thesis) Apr. 1969 206 p refs
(Contract Nonr-4102(01); Proj. MAC)
(AD-689305; MAC-TR-60) Avail: CFSTI CSCL 9/2

The thesis of this dissertation is that formal definitions of the syntax and semantics of computer languages are needed. This dissertation investigates two candidates for formally defining computer languages: (1) the formalism of canonical systems for defining the syntax of a computer language and its translation into a target language, and (2) the formalisms of the lambda-calculus and extended Markov algorithms as a combined formalism used as the basis of a target language for defining the semantics of a computer language. Formal definitions of the syntax and semantics of SNOBOL/1 and ALGOL/60 are included as examples of the approach. Author (TAB)

N69-36918*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
HARDWARE (OR SOFTWARE) PROVISIONS FOR MULTIPLE PRECISION FLOATING-POINT ARITHMETIC
L. Richard Turner Washington Sep. 1969 9 p
(NASA-TM-X-1885) Avail: CFSTI CSCL 09B

A variant of floating-point arithmetic is described which permits the easy realization of indefinite precision within the framework of the floating-point arithmetic. The principal difference of this arithmetic involves the details of floating-point addition. It has been realized in hardware and also simulated. It is proposed that this feature be considered as an option or mode for future computers. Author

N69-36933# Tactical Air Command, Langley AFB, Va. Office of Operations Analysis.
OPERATIONS ANALYSIS COMPUTER SUPPORT THROUGH REMOTE TERMINAL
Bruce C. Jordan, Jr. and Howard J. Talley, Jr. Feb. 1969 18 p refs
(AD-688831; TAC-OA-R-69-4) Avail: CFSTI CSCL 9/2

The report documents TAC OAs experience with remote terminals to an IBM 360/75 time share system and with The RAND Corporation JOSS system. For each system a description is given of the central computer and the corresponding facilities at the computer site. For the IBM system the operation of both a teletype and an IBM 2780 remote terminal is discussed. Experience that has been gained with a teletype terminal to the JOSS system is also outlined. Finally, the capabilities of the 360/75 system is contrasted with the JOSS system. Author (TAB)

N69-37013# Stanford Research Inst., Menlo Park, Calif.
HIGH-INFORMATION-DENSITY STORAGE SURFACES Quarterly Report, 1 Oct.–31 Dec. 1968
Louis N. Heynick, ed. Ft. Monmouth, N.J. ECOM Apr. 1969 56 p refs
(Contract DA-28-043-AMC-01261(E))
(AD-688178; ECOM-01261-15; QR-15) Avail: CFSTI CSCL 9/2

The program is devoted to the preparation and investigation of novel electron-beam-addressable storage mosaics and to the construction of an experimental, large-capacity, high-speed data-storage system utilizing such mosaics. At present, emphasis is on so-called micro-cap mosaics, the elements of which are discrete, submicron-size capacitors at the bases of regular arrays of closely spaced holes in molybdenum/alumina/molybdenum film sandwiches on sapphire substrates. Further work is described on the use of a fine-mesh screen as an array of lenses for electron-sensitive resist exposure. First result of using (1) the screen-lens resist-exposure technique, (2) ion-beam sputtering of molybdenum, and (3) tantalum-fluoride etching of alumina in succession to form arrays of holes having the ultimate packing density are described. Author (TAB)

N69-37038*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
WHY DATA SYSTEM STANDARDS?
W. B. Poland, Jr., R. T. Fitzgerald, and R. J. Coates Jul. 1969 17 p refs
(NASA-TM-X-63653; X-560-69-347) Avail: CFSTI CSCL 09B

One approach to system standards is examined by tracing the origin and growth of such standards at the Goddard Space Flight Center (GSFC) over th e past nine years. Experiences are described which were gained mianly in standardization applications in connection with the Space Tracking and Data Acquisition Network, a collection of tracking, command, and telemetry stations for

ground support of scientific satellites. The system standardization process is conditioned not only by the technical environment but also by the management approach used. The present and planned coverage of data systems by GSFC standards plus considerations bearing on coordination of standards between various activities (e.g., GSFC and IRIG) also are discussed. Author

N69-37139# New York Univ., N.Y. Research Div.
COMPUTER FAILURE DATA
Walter J. Kiernan May 1969 28 p
(Contract N00039-68-C-3579; Proj Sete)
(AD-689376; SETE-210/101) Avail: CFSTI CSCL 9/2

The report is a listing of data derived from malfunction reports made at a large computer installation. The reports describe breakdowns occurring in two computers and the associated peripheral equipment over a one year period. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N69-36235# Joint Publications Research Service, Washington, D.C.
COMPONENTS FOR FUNCTIONAL SYNTHESIS OF RADIO ENGINEERING MICROELECTRONIC EQUIPMENT
L. N. Kolesov 2 Sep. 1969 20 p refs Transl. into ENGLISH from Izv. Vozov SSSR, Radioelektron. (Moscow), Apr. 1969 p 408-420
(JPRS-48724) Avail: CFSTI

Presented and analyzed are some of the problems of the elementary functional transformations used in electronic systems. Also included are estimates of the complexity and scale of these transformations, and a list of several elementary functional components for synthesizing analog and pulse circuits. Author

N69-36255*# Autonetics, Anaheim, Calif.
PROCESS TECHNIQUES STUDY OF INTEGRATED CIRCUITS Quarterly Report No. 11
J. E. Meinhard 15 Feb. 1969 52 p refs
(Contract NAS12-4)
(NASA-CR-86224; QR-11) Avail: CFSTI CSCL 09E

Current activities are concentrated primarily on the origin of dielectric defects where it has been shown that most of the dielectric defects in oxide layers are developed during the cooling of wafers after oxidation and follow an exponential decay with increasing oxide thickness. Present experiments show that diffusion barriers introduced prior to oxidation tend to reduce virtual defect densities and lead to a lateral ion migration model to account for initial inhomogeneous oxide distribution. The present report summarizes investigations which show the effects of hydrogen on integrated circuits to be nonspecific and innocuous. A listing of interactions involving potential package components also has been compiled giving thermodynamic free energy values and kinetic data of possible utility in the prediction of long term device stability. Author

N69-36256*# Autonetics, Anaheim, Calif.
PROCESS TECHNIQUES STUDY OF INTEGRATED CIRCUITS Quarterly Report No. 12
J. E. Meinhard 15 Nov. 1968 12 p refs
(Contract NAS12-4)
(NASA-CR-86225; QR-13) Avail: CFSTI CSCL 09E

Past program activities on oxide passivation have provided insights into the origin of atomic species contributing to inversion and to the origin of dielectric defects. Current activities have shown that most dielectric defects in oxide layers are developed during the cooling of wafers after oxidation and follow an exponential decay with increasing oxide thickness. Compressive stress in the oxide layers due to thermal expansion mismatch with the substrate is directly implicated as a causative factor, and the loci of defects appear to be determined by micron-size surface irregularities in the silicon substrate. Treatments designed to reduce such irregularities produce a corresponding reduction in defects. Examination of oxide impurities is reopened with special reference to their effects on MOS-FET gate performance. Some approaches to the analytical determination of such impurities are given. Author

N69-36267*# Martin Co., Orlando, Fla.
SOLDER STUDY CONDUCTED ON APOLLO TELESCOPE MOUNT GYRO PROCESSOR (GROUP 1 AND 2 TESTS) Final Test Report
D. F. Diel Mar. 1968 58 p
(Contract NAS8-11684)
(NASA-CR-102227; OR-9288) Avail: CFSTI CSCL 09E

Described in this report is an environmental test study to improve solder joint techniques for the Apollo telescope mount (ATM). This report describes two new accelerated test machines and the results of a series of tests on various solder joint arrangements and materials. Author

N69-36276*# Northeastern Univ., Boston, Mass.
INTER-RELATIONS BETWEEN ADVANCED PROCESSING TECHNIQUES, INTEGRATED CIRCUITS, MATERIALS DEVELOPMENT AND ANALYSIS Quarterly Report, 1 Mar.-31 May 1969
B. L. Cochrun, W. Carlson, S. Fine, and W. B. Novak 31 May 1969 15 p refs
(Grant NGR-22-011-007)
(NASA-CR-105631; QR-2) Avail: CFSTI CSCL 09E

A 455 kHz IF amplifier using gyrator tuned circuits was constructed with two transistorized gyrator-amplifier stages connected in cascades. Schematics of the IF and gyrator-amplifier circuits are presented. Work in microcircuit interconnection is summarized for three items: (1) calibration of reflectivity measurements with a reflectance standard, and precision of these measurements; (2) reflectivity measurements on Au/Pt film coupled on glass; and (3) analytical macroscopic solution of the diffusion problem. Charts showing reflectivity versus wavelength for different annealing temperatures for gold and platinum are included. F.O.S.

N69-36365*# Stanford Univ., Calif. Solid-State Electronics Labs.
FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE Quarterly Progress Report, 1 Apr.-30 Jun. 1969
G. L. Pearson 30 Jun. 1969 11 p refs
(Grant NGR-05-020-043)
(NASA-CR-105676) Avail: CFSTI CSCL 09E

The purpose of this project is to prepare power rectifiers and solar batteries which will operate at temperatures up to 500°C. During this quarter, Schottky barrier diodes were formed by nickel evaporation upon undoped GaP grown by vertical liquid

epitaxy, work upon a method to alloy ohmic contacts in the vacuum system used for the metal deposition was started, and an analysis of some device characteristics was made. Author

N69-36420# Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo.
THE TIME DOMAIN BACKSCATTER FROM DIPOLE ANTENNAS ILLUMINATED AT BROADSIDE
Randolph H. Ott 10 Feb. 1969 16 p refs Revised
(Contract PRO-CP-67-823)
(AD-688209; SR-3-2-Rev; AFCRL-68-0308-Rev) Avail: CFSTI CSCL 9/5

The time domain scattering for an isolated dipole and for n uncoupled dipoles is investigated theoretically. The basic approach used is the Fourier transform of the frequency-dependent scattering function. The following qualitative information may be obtained from an investigation of the output waveform: (1) The approximate length of the scatterer (from the resonant frequency of the scattered waveform), (2) an indication of the Q of the scatterer (from the envelope of the output waveform) and (3) the relative separation of n scatterers. Author (TAB)

N69-36489*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTROMAGNETIC INTERFERENCE TEST REPORT OF THE MARINER VENUS 67 CANOPUS SENSOR
D. H. Swenson 15 Jan. 1968 24 p
(Contract NAS7-100)
(NASA-CR-105730; JPL-TM-33-365) Copyright. Avail: CFSTI CSCL 09E

The *Mariner* Venus 67 Canopus sensors (SNs 103 and 107) were tested for electromagnetic compatibility; the testing was performed as a result of an anomaly in the unit's operation which occurred on May 9, 1967, at Cape Kennedy, Florida. The tests were performed during the period May 17 through May 23, 1967, at JPL and Cape Kennedy. The units did exhibit a susceptibility to RF magnetic fields and RF-conducted interference within discrete frequency bands if the applied interference were modulated with the proper range of frequencies. System tests at Cape Kennedy on May 23, 1967, using SN 107, indicated the anomaly was no longer present. Based on testing results, the cause of the initial anomaly cannot be absolutely defined as an EMI problem; yet, the tests performed have proven that the units are susceptible to electromagnetic interference. Author

N69-36513# Sylvania Electronic Systems-East, Needham, Mass. Display and Simulation Lab.
MODULARIZED EL CROSSED-GRID PANEL Final Report, Apr. 1967–Dec. 1968
Robert Bisso, Joseph Hallett, Francis Passavant, and Constantine Rhodes Griffiss AFB, N.Y. RADC May 1969 83 p
(Contract F30602-67-C-0229)
(AD-688274; RADC-TR-69-64) Avail: CFSTI CSCL 9/5

The report details investigations aimed at developing construction techniques for large area plastic dielectric electroluminescent crossed-grid displays using a non-linear resistance suppression layer. The solution to the problem of compatibility between the non-linear resistance material and the lamp material is reported. The report also describes the techniques developed to hermetically seal large area lamps. Author (TAB)

N69-36582*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RADIATION EFFECTS TESTING OF SATURN TELEMETRY HARDWARE
T. C. Lawson *In its* Res. Achievements Rev., Vol. 3, 1968 p 55–63 (See N69-36577 21-17)
Avail: CFSTI CSCL 09B

The radiation effects of nuclear radiation on semiconductor circuits in nuclear powered space vehicles are studied. Three methods of irradiation testing are presented: (1) irradiation of test item to required level while monitoring output, (2) irradiation of test item to required level while monitoring every function, and (3) irradiation of test item to required level and then checking performance. The disadvantage of these is that the only type of information this type test yields is that above a given level of absorbed radiation the circuit does not function. No information is given as to which element of the circuit failed, or which element is still capable of functioning. Testing procedures are described, and test results are included. F.O.S.

N69-36645# Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
DISTORTION PHENOMENA IN A SWITCHING TRANSISTOR MIXER
J. G. Gardiner and D. C. Surana Feb. 1969 21 p refs
(Rept-16) Avail: CFSTI

The nonlinear distortion generated in a switching transistor mixer may be accurately predicted by suitable modification of analysis whose application was restricted to diode modulator and mixer circuitry. Of particular practical importance are the third-order intermodulation and cross-modulation distortion products produced by interaction between the local oscillator and two input signals; these products are examined in detail. Author

N69-36698# Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
CROSS-MODULATION AND INTER-MODULATION DISTORTIONS IN THE TUNED SQUARE-LAW DIODE FREQUENCY CONVERTERS
J. G. Gardiner Nov. 1968 26 p refs
(Rept-11) Avail: CFSTI

Diodes were recently developed possessing very accurate square-law I/V characteristics. An analytical technique is set out for the evaluation of cross-modulation and intermodulation distortions in a tuned frequency-converter using such diodes. The theory is used to predict the distortions obtained under practical conditions and it is shown that, where limited local oscillator power is available, such a converter potentially generates less nonlinear distortion than circuits employing conventional diodes as resistive switches. Author

N69-36708*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
FABRICATION AND CHARACTERISTICS OF MICROWAVE BACKWARD DIODES IN INDIUM ARSENIDE
John B. Hopkins Washington Sep. 1968 25 p refs
(NASA-TN-D-5401) Avail: CFSTI CSCL 09A

The many advantages of backward diodes for microwave mixing and detecting – zero bias, low local oscillator power, low $1/f$ noise, and environmental insensitivity – are significantly offset by the high capacitance associated with a narrow tunneling junction. This either severely limits high-frequency operation or requires small-area junctions which are fragile and susceptible to burnout at low power levels. This limitation can be reduced considerably by selection of a semiconductor with small band-gap and low carrier effective mass, with consequent high tunneling probability and reduced capacitance per unit area. Thus, a device of given size permits higher frequency operation, or equivalent electrical performance with larger area, leading to improved ruggedness and

resistance to burnout. Computer-aided studies of the characteristics of tunneling junctions have confirmed the initial estimate that, among elemental and III-V semiconductors, InAs offers optimum improvement of detector performance. Author

N69-36707# Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
TERMINATING IMPEDANCES IN DIODE MODULATORS AND MIXERS
D. P. Howson Jan. 1969 15 p refs
(Rept-15) Avail: CFSTI

Analysis of diode modulators and mixers is complicated by the need to examine the ratio of source to load impedance. In a number of circuits the optimum ratio is unity, and it is pointed out that a sufficient condition can be developed, allowing in most cases this to be predicted before analysis. Author

N69-36710*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSISTOR PERFORMANCE IN INTENSE MAGNETIC FIELDS
Wayne R. Hudson, Erwin H. Meyn, and Clarence W. Schultz (Conn. Univ.) Washington Sep. 1969 14 p refs
(NASA-TN-D-5428) Avail: CFSTI CSCL 09A

The forward current transfer ratio ($h_{FE} = (\Delta I_{collector}/\Delta I_{base})$) of a germanium junction transistor operating in the common emitter mode is reduced by the application of a magnetic field. This reduction is greatest when the magnetic field vector is perpendicular to the direction of minority carrier motion through the base region. The base thickness is also an important variable. Transistors with smaller base (planar diffused) regions are less affected by magnetic fields. Author

N69-36738# Motorola, Inc., Chicago, Ill. Consumer Products Div.
THE RELIABILITY OF THE QUASAR COLOR TELEVISION RECEIVER
Richard A. Kraft *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 151–158 (See N69-36726 21-15)
Avail: CFSTI

Application of solid state devices in color television receivers resulted in improved reliability and reduction in service costs. A plug-in modular panel design with ten circuit panels made it possible for service technicians to replace major functional elements simply by plugging in a replacement unit at a reasonable charge and thus keep service cost down. The marketing program for a particular solid state color television received good consumer response and thus confirmed the projected appeal of solid state products. G.G.

N69-36764# Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
MICROWAVE INTEGRATION
O. J. Downing and L. J. Hoyle 23 Apr. 1968 8 p refs
(Rept-3) Avail: CFSTI

The present state of research in the rapidly expanding field of microwave integration is reviewed in the light of certain experiments. The techniques and materials employed at present for the manufacture of microwave integrated circuits are listed and an optimistic estimate made of the future use of these devices. Author

N69-36764# Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
THE ANALYSIS OF MIXERS AND FREQUENCY-CHANGERS WITH TUNED TERMINATIONS
D. P. Howson 15 Mar. 1968 16 p refs
(Rept-2) Avail: CFSTI

The circuit performance of mixers and frequency-changers is considered, when the nonlinear element can be represented at a periodically-varying resistance which is an even function of time. Methods for programming a digital computer to calculate the effect of modulation product terminations, and to calculate the effect of imperfect source and load filters are suggested. Techniques for evaluating mixer performance with various image terminations are put forward, and existing methods are reviewed. Author

N69-36765# Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
SINGLE-BALANCED MODULATORS USING SQUARE-LAW RESISTORS
J. G. Gardiner Nov. 1968 35 p refs
(Rept-10) Avail: CFSTI

The potentially low-noise properties and accurate square-law characteristic of the Square-Law Resistor suggest applications in modulating circuits in which large dynamic range and signal-handling capabilities are required. The conversion losses of a number of single-balanced modulators are evaluated, each circuit possessing source and load terminations which are either resistive or, at most, frequency selective over only one band of frequencies. The performance of a practical diode is compared with that of an ideal square-law device, and one possessing zero linear shunt conductance. Author

N69-36768# Joint Publications Research Service, Washington, D.C.
ELECTRONIC AUTOMATIC EQUIPMENT IN THE MILITARY FIELD
V. Sinyak *In its* Selections from Geodesy and Cartography 23 Jul. 1969 p 13–19 Transl. into ENGLISH from Radio (Moscow), no. 2, 1969 p 15–17 (See N69-36760 21-14)
Avail: CFSTI

A discussion is presented on the revolution new electronic equipment has made on warfare. Discussed are the weapons used, electronic equipment, and control of the armament systems involved. It was noted that computers, data processing, and automatic systems are essential for the control and performance of modern day armies and wars. E.H.W.

N69-36836# Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.
LOCKED FREQUENCY MODIFICATION OF A MARK 6(b) SOURCE
Irving Weisman and Seymour Adler Jan. 1969 90 p
(Contract Nonr-266(84))
(AD-688199:; CU-193-69-ONR-266-Phys; TR-185) Avail: CFSTI CSCL 9/1

The modifications to the A Mark 6(b) acoustic transducer enables (1) fixed frequency operation by means of an electronic phase lock control system, and (2) towing at depths to 350 ft by means of a self-regulating air balancing system and cable protecting towing chains and fairings. Author (TAB)

N69-36838# Joint Publications Research Service, Washington, D.C.
AVALANCHE DIODES AND THEIR APPLICATION IN MICROWAVE EQUIPMENT

A. S. Tager et al 21 Aug. 1969 206 p Transl. into ENGLISH of the Book "Lavinno-Proletnyye Diody i Ikh Primeneniye v Tekhnike SVCH" (Moscow), "Soviet Radio", 1968
(JPRS-48664) Avail: CFSTI

Some statistical properties of the process of impact ionization which determines the high frequency fluctuations in avalanche diodes, and consequently the noise level of generators and amplifiers based on these diodes are considered. Characteristics of self-oscillating systems are examined in which the p-n junction of an avalance diode is used as an active element. Also presented are the breakdown nonhomogeneity and its effect on the characteristics of various types of avalanche diodes; avalanche diode oscillators and amplifiers in the centimeter and millimeter wavelength ranges; sychronizing avalanche diode oscillators by an external harmonic signal; and high frequency characteristics of vacuum and tunnel avalanche diodes with dynamic negative resistance. J.A.M.

N69-36839# Army Foreign Science and Technology Center, Washington, D.C.
SUPER HIGH-FREQUENCY AND INFRARED RADIATION MODULATOR. CLASS 21
Yu. K. Pozhela, I. S. Levitas, and A. P. Varyakonte May 1969 6 p Transl. into ENGLISH from Russian Patent No. 175535 (Appl. no. 891454/26-25, 24 Mar. 1964)
(AD-688068; FSTC-HT-23-415-69) Avail: CFSTI CSCL 9/5

A super high-frequency and infrared radiation modulator made in the form of a wave guide by using a semi-conductor plate, characterized by the fact that, in order to simplify the construction and reception of the greatest transverse difference in potentials and surfaces of the plate, it is made, for example, of a monocrystal of germanium so that its wide edges lie in a plane (110), but the direction of the current forms an angle of 30 degrees with the direction (001). Author (TAB)

N69-36848# Air Force Cambridge Research Lab., Bedford, Mass. Microwave Physics Lab.
A SEMI-INFINITE DIPOLE ANTENNA DRIVEN FROM A COAXIAL GUIDE BY A TE SUB 11 MODE
Robert A. Shore Apr. 1969 48 p refs *Its* Phys. and Math. Sci. Res. Papers No. 374
(AD-688807; AFCRL-69-0145) Avail: CFSTI CSCL 9/5

The subject of the report is the problem of a semi-infinite dipole antenna driven in an azimuthally asymmetric manner by a TE sub 11 mode in a coaxial guide. An exact solution is obtained by the Wiener-Hopf technique and expressions derived for the reflection coefficient of the TE sub 11 mode, the directive gain, and the currents on the various conducting surfaces. Plots of the reflection coefficient, current distributions, and directive gain are presented and discussed. Author (TAB)

N69-36850# Electro Technical Analysis Corp., Tucson, Ariz.
UHF POWER AMPLIFICATION WITH SOLID-STATE DEVICES Final Technical Report, Dec. 1967 - Feb. 1969
Alfred J. Hoehn, John M. Hamm, and Michael Andrews Griffiss AFB, N.Y. RADC May 1969 138 p refs
(Contract F30602-68-C-0059)
(AD-688275; RADC-TR-69-96) Avail: CFSTI CSCL 9/5

There is a need for solid-state amplifiers capable of power outputs of 10 to 100 watts in the 225-400 MHz frequency range. Both wideband and tunable narrowband amplifiers are desired. A prime requirement of these amplifiers is that they generate minimal amounts of nonlinear harmonic and sum-difference products. Emphasis on this project was placed on determination of the distortion products generated by UHF solid-state power amplifiers, and the effect of this distortion on various types of communication signals. The work involved theoretical analysis and modeling of nonlinear devices, and included an extensive design and measurement program. Author (TAB)

N69-36920# Army Electronics Command, Fort Monmouth, N.J.
SOLID-STATE PUMPING OF MICROWAVE PARAMETRIC AMPLIFIER
Robert A. Neck Dec. 1968 52 p refs
(AD-688081; ECOM-3052) Avail: CFSTI CSCL 9/5

The effects of solid state pumping on parametric amplifier noise figure have been examined both theoretically and experimentally. The results show that careful consideration must be given to the overall amplifier design in order to achieve satisfactory results. Noise figure degradation of from one to several dB has been observed when a klystron and avalanche oscillator were interchanged on a conventionally designed parametric amplifier. Author (TAB)

N69-36941 Missouri Univ., Columbia.
STABILITY ANALYSIS OF A RELUCTANCE MOTOR WITH DAMPER WINDINGS
Phadej Savasdibutr (Ph. D. Thesis) 1968 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-3283

A synchronous-reluctance motor with damper windings to be operated from a variable frequency power supply is considered. The power supplied is assumed to be a balanced three-phase sinusoidal voltage for all cases. Differential equations representing the reluctance motor are developed from the generalized machine theory using lumped parameters. Idealizing assumptions are employed by assuming negligible saturation, hysteresis, and eddy-current effects. The system equations are simplified by the use of the d-q transformation. From the equations with d-q axis variables, the resulting set of first order differential equations are obtained. Methods are developed to determine machine parameters experimentally. In the stability analysis, the variational equations are obtained from linearizing the set of nonlinear differential equations about an equilibrium point. The Jacobian matrix of the variational equations is calculated by a digital computer for each set of machine parameters. The stability is determined experimentally using balanced three-phase sinusoidal voltages. For several values of voltage, tests are conducted over a frequency range of 20 to 60 hertz. The analytical and experimental results shows a very close correlation. Dissert. Abstr.

N69-36942 Auburn Univ., Ala.
A PHASE STABILITY STUDY SYSTEM FOR VLF PROPAGATION OVER SHORT DISTANCES
Charles Edward Smith (Ph.D. Thesis) 1968 184 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-2247

An engineering design of a unique transponder system for the phase measurement of VLF signals is developed and evaluated. The phase measurement over a two-way path, which is performed by the system, is independent of the incidental phase errors of the associated transmission equipment and is a result of phase-coherent system design. The system design reviews the basic fundamentals of the propagation of electromagnetic energy within the earth-ionospheric cavity for short distances. The required power and the signal-to-noise ratio for the proposed propagation system are investigated. The design techniques associated with VLF receiving and transmitting antennas are discussed and analyzed. The effect of a finite ground conductivity on the over-all propagation in this region is also explored. An engineering design of the system, which meets the requirements for the phase stability measurements, is presented, as well as an antenna design technique for obtaining

increased static antenna capacitance of an umbrella antenna with negligible decrease in effective height. In addition, a computer-aided technique for SNR measurement employing a time interval counter is presented. Dissert. Abstr.

N69-36946 Virginia Univ., Charlottesville.
STABILITY CONSIDERATIONS FOR A CLASS OF PHASE MODULATED SWITCHED SYSTEMS
Charles Edward Nunnally (Ph.D. Thesis) 1968 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-18225

The stability of a class of closed loop switched systems of the SCR (or thyristor) type is considered. The circuit configuration considered is the three-phase delta-wye rectifier. In this connection continuous output current is assumed and no clamping or free-wheeling device is included. It is examined with several different trigger circuits. This enables an operational input-output relationship to be developed for each trigger circuit on a static basis. Each control circuit is examined for its frequency response characteristics. Results show that static linearization does not necessarily permit the switches to be modeled as linear for stability considerations. The describing function method is used for stability analysis. Relative stability information for this nonlinear type system is made available in that phase and gain margin quantities can be obtained from the polar plots used. It is shown that a dual input describing function must be used to examine subharmonic oscillations due to ripple distortion. Experimental verification is presented, and sufficient information is provided to aid a designer in choosing the control circuit best suitable for given applications and conditions of stability. Dissert. Abstr.

N69-36949 Marquette Univ., Milwaukee, Wis.
ANALYSIS OF ONE-PORT COUPLED MICROWAVE OSCILLATORS
George Emil Paul Raue (Ph.D. Thesis) 1968 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-3326

Experimental work is performed at 9.3 GHz and 70 GHz. Frequency, power, and electronic admittance measurements are described. Results are presented describing the characteristics of several different electron tubes and tube types. All four modes of operation are observable with the same reflex oscillator. Operating conditions of reflex oscillators which result in the various operating modes are established. Also established is that the non-monotonic mode is characteristic of reflex oscillators and not caused by external circuit considerations. The loading effect of driver injection is studied by measuring the effective load admittance presented to the oscillator as driver power is changed. Experimental results show that available theory for the locked oscillator mode is applicable to microwave frequency oscillators. These results, obtained for the first time at microwave frequencies, show that the disturbed locked oscillator level can be both greater and less than the undisturbed oscillator power, depending on initial frequency separation between oscillator and driver. The van der Pol theory of nonlinear oscillations, originally developed for low frequency electronic oscillators, is adapted to microwave reflex klystrons. It is shown that this theory explains the two previously known operating modes for the case of small driver injection. dissert. Abstr.

N69-36967# Akademiya Nauk URSR, Kiev.
EFFECT OF A HEMISPHERICAL INHOMOGENEITY OF ELECTRICAL RESISTIVITY ON RESULTS OF ELECTRICAL SOUNDING
V. A. Belash *In its* Geophys. Commun., Issue 22 1967 p 109-122 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

Formulas are derived for trielectrode and dipole devices with the feeding ground and the feeding and receiving dipoles of infinitesimal and finite dimensions located inside and outside a hemispherical inhomogeneity of electrical resistivity. Simple expressions were obtained for asymptotic values of the apparent impedance at long distances between the feeding and receiving grounds. It is established that with feeding and receiving dipoles within the inhomogeneity, the asymptotic values of the apparent impedance differ considerably from the electrical resistivities of the enclosing medium. When the point ground is within the inhomogeneity, the asymptotic values of the apparent impedance are equal to the electrical resistivity of the enclosing medium. Author

N69-36973# Logicon, Inc., San Pedro, Calif.
ANTENNA CONTROLLER-PROCESSOR SYSTEM Final Report, Oct. 1967 - Feb. 1969
Charles A. Hessenflow Jan. 1969 131 p refs
(Contract F19628-68-C-0116)
(AD-688914; AFCRL-69-0060) Avail: CFSTI CSCL 3/2

The AC-PS is a new control system, providing real time, precision pointing capability for the AFCRL 29 foot millimeter wave radio antenna at Prospect Hill, Waltham, Massachusetts. It has achieved enhanced accuracy, flexibility, and ease of use heretofore unavailable. Computations are performed to point the antenna to a desired object, using as inputs the ephemerides of that object and environmental data. New positioning information is generated on a real time basis, consisting of 18 bit azimuth and elevation commands each 40 milliseconds. The control hardware utilizes an IBM 1800 Data Acquisition and Control System plus special interface and test equipment. Functional integration included a complete programming package to provide operator/system interface, communication with IBM software, tracking mode control, and calculations to provide the position commands in real time. The AC-PS has been operational since August 1968. Author (TAB)

N69-36991# Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
THE MINIMUM LOSS OF A GENERAL BROAD-BAND MIXER
D. P. Howson Dec. 1968 9 p refs
(Rept-13) Avail: CFSTI

The value of minimum loss possible in any mixer circuit configuration employing a periodically varying resistance is analyzed for the case when the signal and image frequencies are virtually the same. Identity of these two frequencies is ignored since this would give rise to a zero output frequency. It is shown that, for a diode mixer in which the input and local oscillator frequencies are nearly equal, the minimum conversion loss is quite generally 3 db. This only depends upon the diode behaving as a time-varying resistance, and on the terminating impedances presented to each pair of neighboring modulation products being the same. Author

N69-37015# Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
A LOW-LOSS NARROW-BAND MIXER
D. P. Howson Dec. 1968 8 p refs
(Rept-14) Avail: CFSTI

The second-order ring modulator is adapted for narrow-band mixer use, and is shown to have an intrinsic minimum conversion loss of 0.2db, with a bandwidth double that of conventional narrow-band mixers. Author

N69-37044# Louisiana State Univ., Baton Rouge. College of Engineering.
CIRCULAR ARRAYS OF RADIAL AND TANGENTIAL DIPOLES FOR TURNSTILE ANTENNAS
J. L. Hilburn Jun. 1969 14 p refs
(Contract F44620-68-C-0021; Proj. Themis)
(AD-688801; LSU-T-TR-11; AFOSR-69-1420TR) Avail: CFSTI CSCL 9/5

A method of obtaining a turnstile antenna from a circular array of radial or tangential dipoles is presented. Directivities, approximate current distributions and approximate terminal admittances are given for arrays of 3, 4, and 5 half-wavelength elements for various array diameters. Author (TAB)

N69-37137# Army Electronics Command, Fort Monmouth, N.J.
PHYSICAL CHARACTERIZATION OF THE EMITTER TIME CONSTANT IN MICROPOWER TRANSISTORS
Herbert L. Mette Apr. 1969 22 p refs
(AD-689438; ECOM-3124) Avail: CFSTI CSCL 9/1

An interpretation of the emitter time constant is presented that, in many respects, is more precise and logical than conventional definitions. Under simplified assumptions that particularly apply to high grade transistors in the micropower range, the displacement current in the base region becomes a direct measure for the reduction of emitter efficiency with frequency. On the basis of formalism developed, the emitter time constant is calculated for small and large signal conditions and compared with the switching speed of signals at low power levels. Methods are discussed for optimizing emitter time constants by proper choice of materials and operating conditions. Author (TAB)

N69-37176# Virginia Univ., Charlottesville. Dept. of Physics.
PHYSICS OF SUPERCONDUCTING DEVICES Symposium Proceedings
1967 245 p refs Symp. held at Charlottesville, Va., 27–28 Apr. 1967
(Grant Nonr(G)-00015-67)
(AD-661848) Avail: CFSTI CSCL 20/3

Ideas on the applications of superconductivity were exchanged, and the techniques and devices made possible by the unique properties of superconductors were discussed with emphasis placed on the basic physics and inherent limitations of the devices. For individual titles, see N69-37177 through N69-37198.

N69-37179# Stanford Univ., Calif. High Energy Physics Lab.
THE APPLICATION OF SUPERCONDUCTORS IN THE CONSTRUCTION OF HIGH-Q MICROWAVE CAVITIES
Michael S. McAshan *In* Va. Univ. Phys. of Superconducting Devices 1967 8 p refs (See N69-37176 21-09)
(Contract Nonr-225(69))
Avail: CFSTI

The microwave properties of superconducting surfaces are examined. All tests were conducted using microwave cavities. The surface properties and surface resistance of lead and tin were determined. New cavities were constructed to test residual surface resistance. Niobium surfaces, lead surfaces, and tin surfaces were measured at superhigh frequencies. The data obtained agree with existing data. E.H.W.

N69-37182# Ford Motor Co., Dearborn, Mich. Scientific Lab.
A SUPERCONDUCTING OSCILLATOR-DETECTOR
Arnold H. Silver *In* Va. Univ. Phys. of Superconducting Devices 1967 18 p (See N69-37176 21-09)
Avail: CFSTI

Technical development of a superconducting oscillator-detector and the theories of superconducting tunneling, weak connections, multiply-connected configurations, and the magnetic behavior of superconducting rings are discussed. Basic experiments on the ac Josephson effect and the macroscopic quantization of superconductors leading to the modal response of this particular instrument are reviewed. Characteristic results of the experiments were based on radio frequency studies of superconducting point contacts in which quantum behavior is dominant, and also showed the loss of power at extremely low power levels from the oscillator to an external circuit which was considered to be reversible by correction. Observation of the oscillating detector from essentially dc conditions to 40 kM cps in a single scan demonstrated great potential for a cryogenic detector of very low power and very great sensitivity. M.H.E.

N69-37183# Pennsylvania Univ., Philadelphia. Dept. of Physics.
CURRENT FLUCTUATIONS IN SUPERCONDUCTING TUNNEL JUNCTIONS
D. J. Scalapino *In* Va. Univ. Phys. of Superconducting Devices 1967 19 p Supported by ARPA (See N69-37176 21-09)
Avail: CFSTI

Experimental attempts to measure with some precision the current fluctuations in Josephson junctions and calculations from an analogy are discussed. The analogy is based on power spectrum analysis of resistors by the Nyquist relation, and depends only upon the observed dc current at voltages $V \pm \omega/e$ and those multiple Green's functions which enter into the final form. Solution of the delta function at zero frequency is demonstrated as is the problem of the metastability of persistent currents. Low frequency power spectrum of the voltage fluctuations and the shot noise from the quasi-particle current are also taken into consideration to obtain the final order of magnitude of the observed line width of the current fluctuations of superconducting tunnel junctions. M.H.E.

N69-37185# Bell Telephone Labs., Inc., Murray Hill, N.J.
JOSEPHSON EFFECT FAR INFRARED DETECTOR
Sidney Shapiro *In* Va. Univ. Phys. of Superconducting Devices 1967 16 p refs (See N69-37176 21-09)
Avail: CFSTI

Experiments describing the use of Josephson junctions at high frequencies beyond the superconducting regions are presented. Five junction forms which exhibited the Josephson effect meaning superconductor-barrier–superconductor systems capable of passing a zero-voltage current and their characteristics were reviewed; however, only point-contact junctions were used in this series. Data on Josephson junctions at high frequencies, spectrometer analysis of Josephson current as a function of frequency, in Nb–Nb junctions, and interferograms demonstrating narrow response peaks and a suggestion of periodicity in the response of Ta–Ta and Nb–Nb junctions all demonstrated evidence of an active device. Performance figures obtained for the point-contact Josephson junction detector indicate frequency response, sensitivity, and response time of high sensitivity detectors of millimeter and sub-millimeter radiation. M.H.E.

N69-37190# International Business Machines Corp., Yorktown Heights, N.Y. Watson Research Center.
THE JOSEPHSON JUNCTION AS A SWITCHING DEVICE
Juri Matisoo *In* Va. Univ. Phys. of Superconducting Devices 1967 10 p (See N69-37176 21-09)
Avail: CFSTI

The Josephson junction as a switching device exhibiting transition times of $\leq$ 1 ns and current transfer times of 1 ns or less depending on circuit properties is assessed. Current gain was

achieved since the amount of current required to control the threshold is less than the current flowing through the junction. Typical junction characteristics are presented. J.A.M.

N69-37194# Illinois Univ., Urbana.
A SUPERCONDUCTING PARAMETRIC AMPLIFIER FOR THE MEASUREMENT OF SMALL dc VOLTAGES
Roger P. Ries and C. B. Satterthwaite *In* Va. Univ. Phys. of Superconducting Devices 1967 7 p ref (See N69-37176 21-09)
(Contract DA-28-043-AMC-00073(E))
Avail: CFSTI

A device for detecting and quantitatively measuring very small dc signals in low impedance circuits which employs a time varying mutual inductance between a set of input and output coils to produce parametric amplification of the input signal is discussed. It is shown that the use of superconducting wire in the coils reduces loss caused by resistance and allows substantial power gain to be produced; a useful configuration uses one input and two output coils; the output coils resemble a Helmholtz pair but the two coils are connected in phase opposition; the input coil is mounted coaxially with and centered between the two output coils; and it is operated by being vibrated with approximately simple harmonic motion along the axis of the three coils. Author

N69-37196# General Electric Co., Schenectady, N.Y. Research and Development Center.
FLUXFLOW AND DIRECT CURRENT TRANSFORMERS
Ivar Giaever *In* Va. Univ. Phys. of Superconducting Devices 1967 1 p refs (See N69-37176 21-09)
Avail: CFSTI

The phenomenon of a type II superconductor placed in a sufficiently high magnetic field causing the magnetic field to pentrate the superconductor in certain small areas which will become normal, leaving the rest of the material superconducting is studied. According to Abrikosov's theory, each normal area contains one unit of flux, and they are referred to as quantized vortices or fluxons. When a sufficiently large current is passed along the type II superconductor, the current interacts with the fluxons causing them to move, as was first suggested by Anderson. The relative motion between the fluxons and the lattice causes a voltage to appear along the superconductor. Thus, the type II superconductor is in a resistive, yet superconductive state. By properly taking advantage of the fluxflow which occurs in type II superconductors, a new class of electronic devices can be constructed, such as dc transformers, controllable rectifiers, and fluxpumps. Some of the advantages and inherent limitations of these devices are discussed. Author

N69-37198# Cornell Univ., Ithaca, N.Y. Dept. of Engineering Physics.
OPERATION OF SUPERCONDUCTING INTERFERENCE DEVICES IN APPRECIABLE MAGNETIC FIELDS
Malcolm R. Beasley and Watt W. Webb *In* Va. Univ. Phys. of Superconducting Devices 1967 7 p refs Supported by AEC (See N69-37176 21-09)
Avail: CFSTI

The phenomenon of superconductivity which has been used to develop extremely sensitive magnetometers is studied. The two most prominent approaches are the modulated superconducting inductance and the superconducting quantum interference device (or SQUID). The inherent sensitivity of these devices is investigated. Price claims a projected sensitivity of 10^{-10} gauss for a modulated inductance device and Silver and Zimmerman have detected 10^{-9} gauss using a SQUID. Zimmerman and Silver have also shown that one configuration of the SQUID shows the characteristic critical current modulation in rather strong magnetic fields. This report discusses some of the problems, and describes a device which has been used to study flux creep in superconductors and that is capable of resolving field changes of less than 10^{-7} gauss, with a one sec time constant, in an applied field of 2500 gauss thus obtaining a field resolution of better than 1 part in 10^{10}. Higher field resolution is not necessary for our flux creep experiments so the resolution of the instrument has not been extended to the ultimate limit of the system. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N69-36187*# Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.
DEVELOPMENT OF LITHIUM DIFFUSED RADIATION RESISTANT SOLAR CELLS Quarterly Report
P. Payne 15 Jan. 1969 19 p Prepared for JPL
(Contracts NAS7-100; JPL-952247)
(NASA-CR-105616; QR-3; Rept-9) Avail: CFSTI CSCL 10B

Work on evaporated lithium as a diffusion source continued. Sintering of P/N cells with and without lithium was also studied. Emphasis was placed on those cells without lithium in order to isolate the effect of sintering a TiAg contact on a P/N cell from the effect of heat treatment on lithium diffused cells. The fifth and sixth lots of lithium cells were fabricated. Yield analyses of these cells were made. Author

N69-36233# College of Aeronautics, Cranfield (England). Dept. of Electrical and Control Engineering.
WIDEBAND MEASUREMENT OF TRANSISTOR SMALL SIGNAL PARAMETERS BY TIME DOMAIN SPECTROMETRY
G. M. Young and H. W. Loeb Apr. 1969 26 p refs Sponsored by Sci. Res. Council
(CoA-Note-E/C-5) Avail: CFSTI

The method of time domain spectromatry and its applications to the wideband measurement of the small signal parameters of the transistors are discussed. The advantages and limitations of the method are reassessed both for the present and projected systems in the light of results obtained in investigations directed particularly at establishing the accuracy and range limiting factors of present systems. Comparisons are made between TDS and frequency domain measurement techniques. Author

N69-36289# College of Aeronautics, Cranfield (England). Dept. of Electrical and Control Engineering.
TIME DOMAIN AND FREQUENCY DOMAIN MEASUREMENT TECHNIQUES
H. W. Loeb Jan. 1969 21 p refs Sponsored by Sci. Res. Council
(CoA-Note-E/C-4)

The principles underlying two distinct approaches to the measurement of electrical network characteristics over a wide frequency range are outlined, together with brief descriptions of currently available test systems which cover the range 0.1–4GHz. The two techniques are assessed in terms of their ultimate capabilities with regard to accuracy, speed of measurement and costs. Author

N69-36325# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Systems Research Section.
CLOSED-FORM SOLUTION OF A pn JUNCTION WITH CURRENT
D. Fekete Aug. 1969 44 p refs
(RE-368) Avail: CFSTI

Obtained was a closed-form solution for a symmetrically doped pn junction with current by assuming a simple functional form for the charge density. The solution is characterized by three parameters: the gradient of the impurity density at the center of the junction, the bulk doping density, and the minority carrier lifetime. A strong dependence of the current-voltage characteristics on the first two parameters was found. Comparison of current-voltage behavior with an experimental silicon planar diode shows reasonably good agreement. The constraint of invariant form on the charge density causes a singularity in the electron and hole number densities. Fortunately, the symmetry properties of the junction produce a cancellation of the singularities, consequently, the charge density, electric field, electrostatic potential, and space charge capacitance are not affected. Comparison of space charge capacitance with that of a numerical solution of the linearly graded junction shows good agreement. Author

N69-36524# Joint Publications Research Service, Washington, D.C.
SURVEY OF SOVIET ELECTRONIC INDUSTRY
Satoshi Kojiha et al 22 Aug. 1969 11 p Transl. into ENGLISH from J. Inst. Elec. Commun. Engr. Japan (Tokyo), no. 2, Feb. 1969 p 135–139
(JPRS-48667) Avail: CFSTI

Visits were made to the Soviet Academy of Science, the Ministry of Electronic Industry, and seven laboratories. The Moscow University and three industrial plants were also included on the tour. A description of each of these institutions, its mission, organization, size, and method of operation is included. In addition, information gleaned from specific questions asked at the various plants is also reported. A.C.R.

N69-36733# General Dynamics/Electronics, Rochester, N.Y.
WHEN DOES QUALITY BECOME RELIABILITY (QUES)
J. Douglas Ekings *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 45–66 (See N69-36726 21-15)
Avail: CFSTI

Reliability engineering applied to a complex electronics equipment, requires the use of technical and management methods, if the specified reliability is to be achieved. The reliability program must provide direction to all major functions of the business cycle. Secondarily, use of quantitative data is required to assess the results of these efforts. The assessments, to be effective, must be of a simple and direct form, readily comprehended by production personnel, middle management, and top management. Author

N69-36735# Bell Aerosystems Co., Buffalo, N.Y.
COMPUTER-AIDED RELIABILITY TECHNIQUES IN ELECTRONIC DESIGN
R. A. Nowacki *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 79–105 (See N69-36726 21-15)
Avail: CFSTI

In the past three years there have been many evolutionary changes in some areas of reliability engineering and analysis. Some changes are due to the use of the digital computer as an instrument for implementing reliability theory. The use of modern electronic data processing (EDP) techniques has made the practice of the trial and error approach and various optimization techniques practicable and efficient. This paper will discuss the more frequently used and most successful computer-aided techniques at the disposal of the reliability engineer in the design and analysis of electronic equipment for various applications and environments. Author

N69-36936*# Arizona Univ., Tucson Dept. of Electrical Engineering.
A COMPARISON OF NUMERICAL TECHNIQUES FOR DETERMINING THE PARAMETERS OF DISTRIBUTED RC NETWORKS
L. P. Huelsman and T. A. Liebert [1969] 32 p refs
(Grant NGL-03-002-136)
(NASA-CR-105755) Avail: CFSTI CSCL 09C

The theory and implementation of the matrizant for modeling a distributed RC network are described. Three techniques for using the digital computer to determine the matrizant are discussed. A comparison is made between the use of matrizant methods and the use of a lumped equivalent circuit to model the distributed RC network. In general, the lumped equivalent model is shown to be superior. Author

N69-36948 Missouri Univ., Rolla.
DISTRIBUTED PARAMETER RC NETWORK ANALYSIS
Robert Charles Peirson (Ph.D. Thesis) 1968 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-2258

Methods of analyzing uniform and tapered distribute parameter RC networks are reviewed and correlated. Multilayer networks and simple three layer networks are considered. Analogies between two-wire transmission line theory and multilayer distributed network theory are developed, i.e., standing wave and traveling wave concepts. An accurate computer-aided steady state analysis procedure is presented which has a solution accuracy that can be determined prior to actual analysis computations. The impulsive response of the uniform RC network is investigated with the goal of measuring the network's parameters. Procedures to determine the parameters R and C of a uniform RC microcircuit from transient measurements are included. Dissert. Abstr.

N69-37023# Defence Research Establishment Suffield, Ralston (Alberta).
FREQUENCY TRANSFORMS FROM A TIME RECORD
R. B. Harvey Jun. 1969 25 p refs Presented at the 11th Meeting of T.T.C.P., Apr. 1969
(Suffield-MEMO-37/69) Avail: Issuing Activity

The basic equations are set up to analyze a digitized time function for the component frequencies. The effects of the length of the recording in time, the sampling interval, and weighting of the time data before conversion are discussed. A record of displacement versus time for a complex cantilever structure (Navy mast) is used to illustrate some of the factors discussed. Author

N69-37134# Stanford Univ., Calif. Stanford Electronics Labs.
STANFORD ELECTRONICS LABORATORIES Quarterly Status Report, 1 Jan.–31 Mar. 1969
31 Mar. 1969 108 p refs
(Contract Nonr-225(83))
(AD-689370; SU-SEL-69-015; QSR-113) Avail: CFSTI CSCL 5/2

Contents: Plasma Physics and Quantum Electronics, Radioscience, Solid-State Electronics, Systems Techniques, Systems Theory, and Digital Systems. TAB

N69-37159# Pisa Univ. (Italy). Electronic Inst.
ON THE MEASUREMENT OF THE ELECTRICAL CHARACTERISTICS OF THE FUNCTIONING OF THE SINGLEPHASE AND TRIPHASE TRANSMISSION LINES [SULLA MISURA DELLE CARATTERISTICHE ELETTRICHE DI FUNZIONAMENTO DELLE LINEE DI TRASMISSIONE MONOFASI E TRIFASI]
Franco Nencioni 1968 20 p refs In ITALIAN *Its* Ser. 25, No. 1218
(Pub-112) Avail: CFSTI

The most prevalent devices used on low tension electrical lines of limited length, with single-phase or three-phase transmission are discussed for the case where the voltage and current are below the equivalent impedance which results in voltage loss and voltage drop. Two methods are demonstrated for determining the impedance in the laboratory on a trunk line in which the normal charge conditions are reproduced. One of the methods uses the electric field of the ac after the impedance point, while the other is a potentiometer type. The application of these methods for determining cavity impedance, and for eliminating the errors associated with the discontinuity of the terminal system is shown and the methods are applied to a particular single pole cavity of an insulated mineral. Transl. by F.O.S.

N69-37184# British Columbia Univ., Vancouver.
QUANTIZATION AND FLUCTUATIONS IN SUPERCONDUCTORS
Ronald E. Burgess *In* Va. Univ. Phys. of Superconducting Devices 1967 16 p (See N69-37176 21-09)
Avail: CFSTI

Generally accepted misconceptions about fluctuations in supercurrents and their decay are reviewed. Because the significant omission in these understandings is the contribution of the normal (current) component, three simple systems were selected for the suitable application of the fluctuation-dissipation theorem, considering the case of thermal equilibrium in which persistent current is flowing. The systems are a superconducting ring, a superconducting ring with a Josephson junction, and a dc-biased Josephson junction. Methods for calculating the thermodynamic fluctuations are demonstrated resulting in first order evaluation of the flux, the average current, the line width of the current oscillation, and the state of equilibrium of the system with regard to fluctuations. Equivalent circuit techniques are suggested for simplifying some of the calculations. M.H.E.

N69-37187# Radio Corp. of America, Princeton, N.J.
ON THE USE OF THE ac JOSEPHSON EFFECT TO MAINTAIN STANDARDS OF ELECTROMOTIVE FORCE
Barry N. Taylor, William H. Parker (Pa. Univ., Philadelphia), and D. N. Langenberg (Pa. Univ., Philadelphia) *In* Va. Univ. Phys. of Superconducting Devices 1967 1 p refs (See N69-37176 21-09)
Avail: CFSTI

It was shown how a particular phenomenon arising from the ac Josephson effect in tunnel junctions and point contacts, namely, microwave induced constant-voltage current steps, can be used to provide a comparatively simple and inexpensive means for (1) checking on the constancy of reference standards of emf at the one ppm level for long period of time, and (2) inferring at this same level of accuracy the relationship between the national reference standard of emf of one country and that of another country, thereby contributing to a better international assignment of the volt. The results of recent high accuracy, five ppm measurements of the above phenomenon and the relative ease with which the techniques used in these measurements can be extended to the one ppm level were presented as evidence that these two goals can be reached in the immediate future. Practical considerations such as cost were also discussed as well as the future possibility of using the effect to calibrate emf reference standards in absolute units. Author

N69-37189*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
MILLIDEGREE NOISE THERMOMETRY
Robert A. Kamper *In* Va. Univ. Phys. of Superconducting Devices 1967 5 p refs Supported in part by NASA (See N69-37176 21-09)
Avail: CFSTI CSCL 14B

The use of the linewidth of temperature dependent Josephson radiation for thermometry is theorized. It is proposed that simple equipment could measure down to 1 millidegree, provided that there is no significant source of noise, independent of temperature, which could mask the effect of the bias resistor at low temperature. J.A.M.

N69-37192# Army Electronics Command, Fort Monmouth, N.J.
MICROWAVE MIXING WITH WEAKLY COUPLED SUPERCONDUCTORS
Gerhart K. Gaule, Raymond L. Ross, and Klaus Schwidtal *In* Va. Univ. Phys. of Superconducting Devices 1967 6 p refs (See N69-37176 21-09)
Avail: CFSTI

Diodes with Josephson or similar properties were used as microwave mixers with nonlinear inductance. A digital computer was used to determine essential Fourier components. Logarithmic presentations of the Fourier components of the voltage for various bias conditions are provided. The experimental results show that the pressure contacts of oxidized Nb were far more radiation sensitive than crossed vacuum deposited Pb strips. J.A.M.

N69-37193# Massachusetts Inst. of Tech., Cambridge.
MEASUREMENT OF THE ANISOTROPIC ENERGY GAP IN NIOBIUM SINGLE CRYSTALS BY TUNNELING
M. L. A. MacVicar and R. M. Rose *In* Va. Univ. Phys. of Superconducting Devices 1967 6 p (See N69-37176 21-09)
Avail: CFSTI

Tunneling characteristics on single crystal niobium are presented. Resistivity ratios of the samples were almost 800, and the crystal sections were of approximate orientation (110). The fabrication of the junction, the vacuum system backfilled with nitrogen, and the crystal removed for sectioning are also discussed. J.A.M.

N69-37195# Stanford Univ., Calif.
DEVIC APPLICATION OF SUPER-INDUCTORS
William A. Little *In* Va. Univ. Phys. of Superconducting Devices 1967 17 p (See N69-37176 21-09)
Avail: CFSTI

The applications of superconductivity to practical devices are discussed. Among the suggested uses are: (1) to measure temperature, (2) logic devices to direct current pulses through a maze, (3) as low noise parametric amplifiers, (4) in delay lines, and (5) as storage elements for computer readout. These devices are shown to be well adapted to microminiature circuits, and are simple to construct. F.O.S.

N69-37197# Ford Motor Co., Newport Beach, Calif. Scientific Lab.
MODULATED FLUX FLOW IN SUPERCONDUCTING FILMS

James E. Mercereau *In* Va. Univ. Phys. of Superconducting Devices 1967 7 p ref (See N69-37176 21-09)
Avail: CFSTI

A Giaever type ac transformer is analyzed with the assumption that the secondary coil is completely superconducting. It is shown that the emf induced is at the edges because the flux penetration is resisted. When the magnetic field increases until the critical current is reached the magnetic field penetrates the walls. This action of the superconductor is compared to a flux valve, and is considered a magnetometer. F.O.S.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N69-36224*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
NASA HIGH TEMPERATURE LOADS CALIBRATION LABORATORY
Walter J. Sefic and Karl F. Anderson Washington Sep. 1969 13 p refs
(NASA-TM-X-1868) Avail: CFSTI CSCL 14B

The NASA High Temperature Loads Calibration Laboratory and the equipment it contains for simulating the loading and heating of aircraft or their components are described. Particular emphasis is placed on various fail-safe devices which are built into the equipment to minimize the possibility of damage to flight vehicles. The data-acquisition system is described. This system involves on-site pickup of data and signal conditioning coupled with conversion from analog to digital data and transmission to a central area for recording on magnetic tape and distribution to real-time displays. Instrumentation available in the facility for measuring load, position, and strain is also discussed. Author

N69-36356# Congress. House. Committee on Science and Astronautics.
ENGINEERING MANAGEMENT OF DESIGN AND CONSTRUCTION OF FACILITIES OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington GPO 1968 81 p Presented to Comm. on Sci. and Astronaut., 91st Congr., 1st Sess., Serial G, 11 Aug. 1969
Avail: Subcomm. on NASA Oversight

Congressional subcommittee report provides a cost accounting of the engineering management dealing with the design and construction of facilities at NASA field centers. The findings of a nationwide staff survey are reported for all of the principal space installations, including detailed tables of design, construction, and management costs for more than 200 projects. Various methods of engineering supervision are analyzed, and certain conclusions are advanced regarding management policies and procedures that may be pertinent to future facility development. Author

N69-36370# Institut Franco-Allemand de Recherches, St. Louis (France).
DEVELOPMENT OF AN ELECTROTHERMAL MICROMETEOROID SIMULATOR FOR THE VELOCITY RANGE FROM 10 TO 20 KM/S [ETUDE D'UN SIMULATEUR ELECTROTHERMIQUE DE MICROMETEORITES DANS LA GAMME DE VITESSES DE 10 A 20 KM/S]
G. Herbette 10 May 1968 29 p refs In FRENCH; GERMAN summary
(ISL-T-18/68) Avail: CFSTI

The design of this simulator is based on the expansion of a vaporized lithium mass set off by the 1.5-μs discharge of a single condenser with the relatively low energy of 3500 joule. The simulator was used to accelerate micro glass spheres of 50 μm dia to velocities of nearly 20 km/s. This comes close to velocities attained with other accelerators that function on the same principle but require energies up to 20,000 joule and the correspondingly higher technical and financial outlay. It is concluded that electrical power is directly responsible for high acceleration rates. Transl. by K.W.

N69-36447# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Geo-Astrophysics Section.
ON THE APPLICATION OF LAND LOCOMOTION THEORIES AND EXPERIMENTAL RESULTS TO THE PROBLEM OF LUNAR LOCOMOTION
L. L. Karafiath Aug. 1969 39 p refs
(RM-454) Avail: CFSTI

The principal land locomotion theories are reviewed with respect to their applicability to lunar locomotion problems. The basic assumption of the Bekker theory which equates the pressure distribution beneath wheels transmitting an inclined load to the ground with that beneath plates loaded vertically, is an inadmissible simplification in the case of steep slopes. The approach of the U.S. Army Corps of Engineers Waterways Experiment Station is based on Freitag's dimensional analysis. The performance relationships between independent dimensionless parameters are empirically determined. The simultaneous consideration of friction and cohesion as well as the effect of reduced gravity and slopes would lead to an extensive and possibly not feasible testing program. The properties of the lunar surface layer are such that the basic differential equations governing the plastic equilibrium of soils apply. On this basis it is possible to establish stress gradients for the pressure distribution beneath wheels for any loading conditions. The application of the concept of stress gradient is recommended for lunar locomotion studies. Author

N69-36700# Federal Aviation Administration, Washington, D.C. Airports Service.
AVIATION DEMAND AND AIRPORT FACILITY REQUIREMENT FORECASTS FOR MEDIUM AIR TRANSPORTATION HUBS THROUGH 1990
Jan. 1969 239 p refs
(AD-68826) Avail: CFSTI CSCL 1/2

The report presents a complementary extension of a previous publication on airport facility requirements for large air transportation hubs. The large and medium hub forecasts supplement each other and enhance advance planning of the financial and physical airport facility development required to meet the air transportation needs of 1980. They are also intended to assist in promoting the development of comprehensive, long-range metropolitan airport system plans by airport and local government planning officials. Author (TAB)

N69-37022*# Chrysler Corp., Detroit, Mich.
EXPERIMENTAL VERIFICATION OF SURFACE VEHICLE DYNAMICS
B. D. Van Deusen, J. M. Snayd, C. H. Hoppe, and R. F. Hughes Washington NASA Sep. 1969 139 p refs
(Contract NASw-1607)
(NASA-CR-1398) Avail: CFSTI CSCL 13F

Techniques were developed to allow prediction of the dynamic response of vehicles traversing yielding and nonyielding rough surfaces. Virgin terrestrial and extraterrestrial surfaces were classified according to their frequencies and amplitude distribution. An attempt to verify these conditions was undertaken. A four wheeled truck and a specially designed single wheel trailer were instrumented and driven (pulled) across both yielding and nonyielding surfaces. The surface profile was measured on both surfaces and soil parameters were measured on the yielding surface. With this input information the theoretical prediction was compared with the physical measurements in a statistical fashion. The analog computer simulation was converted to a digital computer simulation to allow a more useful and versatile prediction technique. Author

N69-37048# Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Aerodynamic Research Dept.

RESEARCH ON ADVANCED GASDYNAMIC TEST FACILITIES. PART 1: THEORETICAL AND EXPERIMENTAL STUDIES OF THE ISENTROPIC COMPRESSION TUBE

Interim Scientific Report, 1 Jul. 1966–31 Mar. 1968

Frank J. Stoddard Jan. 1969 84 p refs

(Contract AF 33(615)-5389)

(AD-688910; AD-2297-A-2; ARL-69-0001) Avail: CFSTI CSCL 14/2

The report describes the current status of the theory of the isentropic-compression tube and discusses several experiments which have been conducted in a pilot facility. The theoretical portion deals with two possible techniques, the braked-piston and the free-piston, for producing the isentropic flow. According to theoretical analysis, an approximation to a focused, nonsteady, isentropic-compression wave can be produced with the braked-piston method which involves a mechanically simple modification to the motion of an otherwise freely moving piston. This method would provide two distinct isentropic test flows at different positions in the tube. In the free-piston method, no modification to a free-piston trajectory is necessary but only one test region is produced. The discussion of the experiments deals with the construction and testing of a low-pressure pilot facility. It is shown that the compression process in the pump tube is very close to isentropic. Initial attempts at producing an isentropic flow using the free-piston method are described. It is shown that a close approximation to the theoretically predicted flow was achieved although the flow duration was smaller than expected. Author (TAB)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N69-38011*# Purdue Univ., Lafayette, Ind.

SOUND WAVE SHEAR WAVE INTERACTION WITH OBLIQUE SHOCK FRONTS Final Report, 1 Sep. 1967–31 Aug. 1968

Kenneth R. Purdy 31 Aug. 1968 132 p refs

(Grant NGR-15-005-056)

(NASA-CR-98243; PRF-5115) Avail: CFSTI CSCL 20D

The flow field downstream of an oblique shock front that is perturbed by either plane sound waves or plane spear waves is studied. The sound wave analysis predicts that under certain conditions there exists an angle of incidence which produces shock wave resonance. This results in a large amplification of the sound pressure and in large amplitude motion of the shock front itself. Experimental studies of sound wave-shock front interaction showed that the shock front is definitely excited by an impressed acoustic field. The shock front motion is periodic and at the same frequency as the impressed sound field. Natural pressure fluctuations in the upstream flow also excited the shock front and amplifications at the shock front of 22 to 30 dB were found for frequencies from 20 to 2000 Hz. The shear wave analysis contains some anomalies that have not been reconciled. Author

N69-38018 Houston Univ., Tex.

MEASUREMENTS OF PRESSURE-INDUCED INFRARED FREQUENCY SHIFTS AND A THEORY OF LIQUIDS BASED ON HINDERED MOLECULAR VIBRATION

Cheng-Shan Feng (Ph.D. Thesis) 1968 318 p

Avail: Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 69-771

A high resolution and precision infrared spectrophotometer and a high pressure infrared cell were designed, constructed and calibrated for static measurements of frequency shifts at various pressures. The transmittance of each absorption band was measured at the static condition of the monochromator, and fitted to a simplified Lorentz equation from which the minimum of the band was determined. A digital computer was used in the processing of data. A relationship between the frequency shift and the self-consistent potential field in which the molecule vibrates was derived. In still another approach, mathematical relationships were derived for calculation, from the shift data, of the number of effective neighbors, and the number of nearest neighbors for polyatomic molecules in the liquid state. Pressure (volume) and solvent effects on the stretching vibration of the C=C bond of cis pentene-2 were measured. The pressure varies from 1 atm to 5000 atm. Dissert. Abstr.

N69-38024 Houston Univ., Tex.

EQUIPMENT FOR HIGH PRESSURE INFRARED ABSORPTION, PVT, AND CONFIGURATIONAL PROPERTIES OF LIQUIDS: MEASUREMENTS OF CIS-PENTENE-2 AND MIXTURES

Jerry Van Fox (Ph.D. Thesis) 1968 215 p

Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-2020

The continued study of the liquid state included the development of a Perkins-type PVT apparatus for measurements up to 10,000 atmospheres, a semiconductor strain gauge pressure transducer, and a 0–1500 atmospheres variable path length IR cell. PVT measurements were made and correlated, and certain configurational thermodynamic properties calculated. The strain gage pressure transducer measures pressure with an accuracy of 5.5 parts per 10,000 at 10,000 atmospheres. The Perkins PVT apparatus determines volume with a maximum uncertainty of 3–4 parts per 1000. The PVT data covers the range 0–6000 atmospheres and 24 to 200°C. Measurements were made on cis-pentene-2, and mixtures of cis-pentene-2 and carbon tetrachloride, and cis-pentene-2 and chloroform. A procedure for calculating the configurational properties of liquids was extended and used to determine the configurational energy and entropy of aforementioned systems. Dissert. Abstr.

N69-38102# Nielsen Engineering and Research, Inc., Palo Alto, Calif.

INHIBITION OF FLOW SEPARATION AT HIGH SPEED. VOLUME 3: EXPERIMENTAL RESULTS FOR LAMINAR BOUNDARY LAYERS

Jack N. Nielsen, Larry L. Lynes, and Frederick K. Goodwin Wright-Patterson AFB, Ohio AFFDL Mar. 1969 63 p refs
(Contract F33615-67-C-1096)
(AD-686800; NEAR-TR-9; AFFDL-TR-68-119-Vol-3) Avail: CFSTI CSCL 20/4

The report describes the results of a wind tunnel test program on an ogive-cylinder-flare combination to determine the extent of laminar separation as a function of wall temperature for fixed free-stream Reynolds number per unit length at a free-stream Mach number of 8.0. The objective of the tests was to see if separation could be eliminated entirely by cooling the wall to a sufficiently low value. Pressure and temperature distributions spanning the separation region were made on a quick-insertion model, but the location of the separation point could not be obtained during the tests. Accordingly, a combined experimental-theoretical method was developed for determining the separation point location. Correlation of the separation length with model temperature ratio indicated that the separation distance was small and was rapidly approaching zero at the lowest wall temperature ratio achieved experimentally. The apparent critical wall temperature ratio so indicated by the data was lower than the theoretical ratio. It was not possible to achieve sufficiently low temperatures to see if separation could be entirely eliminated. Possible reasons for the difference between experiment and theory are discussed. Author (TAB)

N69-36103# Nielsen Engineering and Research, Inc., Palo Alto, Calif.
INHIBITION OF FLOW SEPARATION AT HIGH SPEED. VOLUME 4: CALCULATION OF NONADIABATIC LAMINAR BOUNDARY LAYERS ON CONICAL COMPRESSION SURFACES Technical Documentary Report, Oct. 1966–Oct. 1968
Frederick K. Goodwin and Larry L. Lynes Wright-Patterson AFB, Ohio AFFDL Mar. 1969 56 p refs
(Contract F33615-67-C-1096)
(AD-686801; NEAR-TR-10; AFFDL-TR-68-119-Vol-4) Avail: CFSTI CSCL 20/4

The purpose of the report is to extend other work to configurations representative of axisymmetric compression spikes. The analysis is developed and a computer program written for a spike which consists of a conical nose on which separation occurs followed by a compression surface. No data were found to compare with the theory. A calculation made with the pressure gradient prescribed by the body shape rather than by free interaction is compared with experiment. The comparisons, which were made for skin friction, heat transfer, and pressure distributions, were good. The significant effect of wall cooling in delaying separation for the prescribed pressure gradient case is shown. It is also shown that a free-interaction solution can be joined to a prescribed pressure gradient solution so that the solution will go smoothly through separation to reattachment. Author (TAB)

N69-36113# Institut Franco-Allemand de Recherches, St. Louis (France).
LOCAL MEASUREMENTS OF THE SHOCK WAVE PRESSURE REGIME NEAR AN ABRUPT CHANGE IN THE CROSS-SECTION OF A TUNNEL [ETUDES LOCALES DU REGIME DES PRESSIONS AU VOISINAGE D'UN CHANGEMENT BRUSQUE DE SECTION D'UNE GALERIE PARCOURUE PAR UNE ONDE DE CHOC]
G. Kronenberger and C. Thery 17 Feb. 1969 67 p In FRENCH; GERMAN summary
(ISL-T-7/69) Avail: CFSTI

Pressure measurements, shadowgraph photography, and interferometry were used in the investigation. At moderate shock wave intensities ($\Delta P/P_0 \simeq 1$), the pressure developments are rather constant, and perturbations are caused only by the successive shock reflections. At stronger shock wave intensities ($\Delta P/P_0 \simeq 3$ or 5), the pressure flow near the change in the cross section becomes very irregular, and new compression waves are formed whose expansion increases with the intensity of the shock wave. The pressure acting on the surface of the flanks becomes rapidly stabilized in all cases. The photographs and color interferograms illustrating the pressure regimes are included in this report. Transl. by K.W.

N69-36116 Princeton Univ., N.J.
SUFFICIENCY CONDITIONS FOR THE HYDRODYNAMIC STABILITY OF CERTAIN VISCOELASTIC FLUID MOTIONS
Martin Robert Feinberg (Ph.D. Thesis) 1968 218 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 69-2535

Sufficiency conditions are established for the hydrodynamic stability of some motions of incompressible fluids described by the infinitesimal and finite linear theories of viscoelasticity. The technique utilized is based upon an adaptation of a previous approach for incompressible Newtonian fluids. In cases in which the infinitesimal theory is presumed to approximate material behavior, sufficiency conditions are established for a wide variety of flow geometries; special attention is paid to the problems of Poiseuille and cylindrical Couette flows. The problem of stability of cylindrical Couette flow of an incompressible fluid described by the finite linear theory of viscoelasticity is approached. It is assumed that the onset of instability is characterized by a steady secondary motion. The sufficiency condition obtained appears to be very conservative, but there is a conflict between the stability bounds derived and the instability predicted earlier for the case in which both cylinders rotate at almost the same high speed. Dissert. Abstr.

N69-36124# Institut Franco-Allemand de Recherche, St. Louis (France).
CALCULATING THE PROPAGATION OF A SHOCK WAVE IN A TUNNEL BY MEANS OF A FINITE DIFFERENCE METHOD [CALCUL DE LA PROPAGATION D'UNE ONDE DE CHOC DANS UNE GALERIE PAR UNE METHODE DE DIFFERENCES FINIES]
F. Reggiani 13 Dec. 1968 32 p refs In FRENCH; GERMAN summary
(ISL-T-46/68) Avail: CFSTI

A numerical method was tested which takes into account the time-dependent conditions at both tunnel openings as parameters. The model represents a 20-megaton explosion at ground level on the center line of the tunnel, with the entrance a distance of 2800 m from the explosion. The tunnel may be open at both ends (length 1000 m) or closed (length 600 m). The results indicate that the finite difference method is sufficiently accurate for such a problem. The major error source in the physical conditions appears to be the neglect of viscosity. Transl. by K.W.

N69-36139 Wisconsin Univ., Madison.
DYNAMICS OF THIN LIQUID FILMS, SURFACE TENSION DRIVEN FLOWS AND SPONTANEOUS SPREADING
Vilhjalmur Ludviksson (Ph.D. Thesis) 1968 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-14006

Surface tension driven flows on vertical solid surfaces, with particular attention to hydrodynamic stability and spontaneous spreading are analyzed, and methods to test the theoretical results

quantitatively are devised. The results show that relatively small concentration or temperature gradients can explain many of the phenomena reported. Equations were derived to relate surface tension gradients to flow behavior and film thickness, and approximate predictions were obtained for spontaneous spreading rates of liquids on solids as a function of surface tension gradients. The stability of these films to lateral perturbations in thickness was investigated and the results suggest that such instabilities might be of great significance for the thicker films expected in various types of heat or mass transfer devices. The hydrodynamics of spontaneous spreading were investigated in considerable detail and the difficulty arising from the no-slip boundary condition was pointed out. A temperature controlled silver plate capable of giving well defined and measurable temperature gradients was constructed and used to test several of the theoretical results. Excellent agreement with prediction was obtained for film thickness as a function of flow rates and the applied surface tension gradients. Qualitative evidence was found for the concept of the primary film and its effect on film shape and spreading. Dissert. Abstr.

N69-36194# Institut Franco-Allemand de Recherches St. Louis (France).

FOCUSING OF A LASER IMPULSE ON THE FRONT OF A LARGE-CALIBER PROJECTILE [FOCALISATION D'UNE IMPULSION LASER SUR L'AVANT D'UN PROJECTILE DE GROS CALIBRE]

H. Fagot and M. Giraud 5 Jun. 1968 47 p refs In FRENCH; GERMAN summary
(ISL-T-16/68) Avail: CFSTI

The 1-joule impulse of a Q-switched laser was focused on the face of a cylindrical projectile moving at various speeds between 300 to 800 m/s in air at normal pressure. The laser markings on the retrieved projectiles in general turned out to be less pronounced than those on a stationary target. The time sequence of the shock wave flaring out from the front to the detached bow wave was observed, and the shock wave velocity was compared with that of a stationary target. Preliminary studies on the damping of a typical laser-induced shock wave are mentioned. Transl. by K.W.

N69-36195# Institut Franco-Allemand de Recherches, St. Louis (France).

FOCUSING A LASER IMPULSE ON THE FRONT OF 20.7-MM-DIA PROJECTILE HAVING A VELOCITY OF 8 KM/S [FOCALISATION D'UNE IMPULSION LASER SUR L'AVANT D'UN PROJECTILE DE CALIBRE 20, 7 MM A 8 KM/S]

5 Jun. 1968 44 p refs In FRENCH; GERMAN summary
(ISL-T-17/68) Avail: CFSTI

The perturbations caused by a laser penetration of the side wall of a high-velocity projectile were previously studied. Although this was found to cause a change in the flow distribution, the aerodynamic coefficients and the trajectory appeared to remain unaffected. The tests reported here are a continuation of these studies. A 1-joule laser impact was now produced on the flat front of the projectile, an area where such thermodynamic conditions as temperature, pressure, and ionization are severe due to the nearly flat bow wave. The experimental arrangements are described in detail, and the observed laser-induced shock waves are compared with those caused by the detonation of conventional explosives. Approximately 10%, or 0.2 joule, of the energy of the laser beam was found to have been transferred to the gas following the penetration. This energy is too low to affect the trajectory of the projectile. Transl. by K.W.

N69-36196# Institut Franco-Allemand de Recherches, St. Louis (France).

STUDY OF THE WAKE OF PROJECTILES BY MEANS OF LASER RADIATION [UNTERSUCHUNG DES NACHLAUFS VON GESCHOSSEN MITTELS LASERSTRAHLUNG]

H. J. Pfeifer (Ernst-Mach-Inst., Freiburg i. B.) and B. Koch 8 Apr. 1968 27 p refs In GERMAN; FRENCH summary
(ISL-T-7/68) Avail: CFSTI

A 4-mm-dia laser beam was used to probe the wake of 30-mm-dia projectiles moving in a free atmosphere at supersonic velocities in the Mach range from 1.7 to 3.3. The spin angles of the tube were 0°, 2°, or 7.5°. Good registrations were obtained of the compression shocks and the rarefaction waves occurring in the immediate vicinity of the projectile. Comparison with shadowgraphs taken simultaneously showed the laser method to have far better sensitivity. In addition, the laser method indicated the characteristic differences caused by the variation of the spin angle, while the shadowgraphs failed to reflect this. A simple statistical analysis was performed to obtain data on the properties of free turbulence in the far wake of the projectiles. Transl. by K.W.

N69-36200*# Martin Co., Denver, Colo.

ZERO-GRAVITY LIQUID/GAS SEPARATOR Final Report

Sep. 1969 44 p
(Contract NAS9-9526)
(NASA-CR-101886; MCR-69-468) Avail: CFSTI CSCL 20D

A laboratory prototype liquid/gas separator was designed, fabricated, and tested to prove the principle of the hydrophilic screen separation process. The screen technology was developed while designing a hydrophilic screen for a propellant expulsion tank. Two basic test systems were evaluated. One system evaluated the above parameters against only the discharge line flow resistance. The second system evaluated only flow performance against a 0.6-psig head as required by the contract. Performance tests indicated that maximum liquid/gas separation flow rates of 1 gpm liquid at 10 scfm gas can be achieved for the no delivery head system. Filtration techniques evaluated were a cone filter placed inside the separator screen, a fine filter, and a gross filter installed in the two-phase inlet. Urine was run through the separator simulating a urination-rinse cycle. Separation was effective, and short-time compatibility was observed. Author

N69-36237 Maryland Univ., College Park.

NON-GRAY RADIATION EFFECTS ON MIXING OF NON-SIMILAR GASES

Sin Keun Oh (Ph.D. Thesis) 1968 224 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-2518

A numerical analysis is developed to investigate the interaction of radiation with conduction, convection and diffusion in a non-gray, emitting and absorbing mixture of gases. The specific flow problem treated is the turbulent mixing of an axisymmetric jet issuing into a medium at rest. The gases are considered to be non-reacting, and thermally perfect. Step distribution models of the non-gray spectral absorption coefficient variation for each species were used. The validity of the Beer's Law for a gas mixture of carbon dioxide and water vapor was examined, and the non-gray absorption coefficient of a gas-mixture was derived as the function of each species using the Beer's Law. The exact formulation of the interaction of radiation, conduction, convection, and diffusion in a non-gray, emitting and absorbing gas-mixture of non-similar gases is represented by a non-linear multi-integrodifferential equation. Three typical examples were treated: (1) injection of 2,000°K carbon dioxide into a quiescent medium of 300°K water vapor; (2) injection of 10,000°K air into a quiescent medium of 1,000°K carbon dioxide; and (3) injection of 12,000°K air into a quiescent medium of 1,200°K carbon dioxide. The results of non-gray radiation

calculation were compared with those of gray-gas approximation. In general the temperature distribution for non-gray gas remains at a higher level than that for gray-gas. Dissert. Abstr.

N69-36243 Virginia Polytechnic Inst., Blacksburg.
RADIATION-INDUCED PRECURSOR FLOW FIELD AHEAD OF A REENTERING BODY
George Louis Smith (Ph.D. Thesis) 1968 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-3036

The flow field induced ahead of the shock wave by radiation from the gas cap is analyzed. A small perturbation approach is used, whereby it is found that the governing equation for the potential of the velocity perturbation is the wave equation, as for classical supersonic flow, with a driving term due to radiation absorption. This term includes the effects of photoionization, photodissociation, and enthalpy increase. The case of a spherically symmetrically radiating point source is considered. This is an idealization of a radiating gas cap on a blunt body. A simple approximate solution for the perturbation potential valid for high Mach numbers is obtained. From this solution, it is found that the static pressure increases due to the radiation absorption, which causes the longitudinal velocity to decrease, and also induces an outward radial velocity. This outward flow reduces the mass and momentum flux along the streamline going through the source. The case of a cylindrically symmetrically radiating source is also considered. This case is an idealization of a segment of a radiating wake. It is found that near the centerline the flow tends to converge in one region and then to diverge. An order of magnitude increase in static pressure and temperature occurs ahead of the shock wave for velocities exceeding 50,000 ft/sec at a 200,000-ft altitude. A region is defined where the present linearized theory becomes invalid. Dissert. Abstr.

N69-36279# National Aeronautical Establishment, Ottawa (Ontario).
SMALL CROSS-FLOWS IN THREE-DIMENSIONAL LAMINAR BOUNDARY LAYERS WITH SUCTION OR INJECTION
Y. Y. Chan Feb. 1969 30 p refs
(NRC-10748; LR-520) Avail: CFSTI

Three-dimensional laminar boundary layers with suction or injection are examined by using an approximate method based on a small cross-flow assumption. The basic equations are derived in detail and the computational method is developed. The method is tested against exact solutions and is found to be reasonably accurate. Two examples with the same external condition, but with different surface conditions, are analyzed. In one case the distribution of the normal velocity at the surface satisfies the similarity requirement and in the other case the normal velocity is constant over the complete surface. Although the results of these two cases are different in detail, the general trend of both shows that the three-dimensional behaviour of the boundary layer diminishes with suction and amplifies with injection. Author

N69-36286*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
TURBULENT BOUNDARY-LAYER CHARACTERISTICS ON A ROTATING HELICAL BLADE
Ahmad Jabberi (M.S. Thesis) Sep. 1969 109 p refs
(Grant NGL-39-009-007)
(NASA-CR-105649) Avail: CFSTI CSCL 20D

The purpose of the present investigation is to study both analytically and experimentally the turbulent boundary layer characteristics on a rotating helical blade of small aspect ratio enclosed in an annulus. The investigation includes the measurement of main stream and radial velocity profile, boundary layer growth and skin friction. Mager's quadratic expression for the cross flow and the shear stress profile used by von Karman are employed as the starting point. The validity of these assumptions is tested by experimental observations. Author

N69-36372# Institut Franco-Allemand de Recherches, St. Louis (France).
SHOCK WAVE PROPAGATION IN TUNNELS. PART 1: PRELIMINARY LITERATURE STUDY [PROPAGATION DES SOUFFLES EN GALERIE. 1ERE PARTIE: APPROCHE BIBLIOGRAPHIQUE]
L. Bobin 20 Dec. 1968 84 p refs In FRENCH; GERMAN summary
(ISL-T-64/68) Avail: CFSTI

From a survey of the literature dealing with methods for determining the attenuation of a shock wave in a tunnel, two were selected for closer study. These two works are: (1) a semi-empirical approximation method which permits the prediction of the intensity of a shock wave whose propagation is affected by viscous friction and expansion; and (2) a theory on boundary layer effects in the shock tube and application of this theory to loosely defined shock waves. Numerical calculations were performed as part of the critical evaluation of these studies. All of the references that were surveyed are listed. Transl. by K.W.

N69-36373# Institut Franco-Allemand de Recherches, St. Louis (France).
CONSIDERATIONS REGARDING THE APPLICATION POSSIBILITIES OF A SHOCK TUBE HAVING A RIDE-DIAMETER FLOW SECTION AND A SMALL-DIAMETER DRIVE SECTION FOR STUDYING IONIZATION RELAXATION IN AIR [UEBERLUNGEN UEBER DIE VERNENDUNGSMOEGLICHKEIT EINES STOSSWELLENROHRES MIT WEITEM LAUF- UND ENGEM TREIBROHR ZUM STUDIUM DER IONISATIONSRELAXATION IN LUFT]
H. Net 31 Jan. 1968 58 p refs In GERMAN; FRENCH summary
(ISL-T-9/68) Avail: CFSTI

Shock waves, contact discontinuities, and stationary and non-stationary expansions are reviewed for conditions in this type of shock tube under the assumption of ideal gases with constant specific heat. The analytical relationship between initial conditions in the two different sections and the velocity of the resulting shock waves are examined. A computer program is described which permits the numerical calculation of the shock Mach number while taking into account the high-temperature effects in the shock-heated air. The program also gives state conditions of the shock-heated air, including electron density and shock frequency between electrons and neutral particles. The time available for the measurements was estimated, compared with the expected relaxation times, and used to optimize the working area for measuring the ionization relaxation in the membrane shock tube. Transl. by K.W.

N69-36374# Institut Franco-Allemand de Recherches, St. Louis (France).
STUDY OF THE NEAR WAKE OF HYPERVELOCITY SPHERES USING LIGHT ABSORPTION AND EMISSION OF THE ABLATION PRODUCTS [ETUDE DU SILLAGE PROCHE DE SPHERES EN VOL HYPERSONIQUE PAR L'ABSORPTION ET L'EMISSION LUMINEUSES DES PRODUITS D'ABLATION]
J. Vauvrecy and H. Fagot 20 Dec. 1968 47 p refs In FRENCH; GERMAN summary
(ISL-T-61/68) Avail: CFSTI

Light absorption and ablative emission products of hypervelocity spheres are two methods used for viscous flow visualization in the immediate vicinity and near wakes of projectiles. Shown are photographs of polycarbonate and polyethylene spheres of 7 and 8 mm diameter that are followed by turbulent wakes. The radial absorption distribution is computed from density registrations vertical to the axis between the projectile bottom surface and the constricted area of the wake. The concentration of the absorbing products increases toward the axis. Emission measurements are obtained on spheres fired at more than 5 km/s in nitrogen at a pressure of 50 torr. Analyzed are photographs by an electric camera containing a 5 11-cathode: the emission at the outer rim is stronger than along the axis; this shows that the temperature is higher along the axis. This effect is more pronounced with polyethylene spheres. Ablation products from polycarbonate spheres exhibit some mechanical and thermal inertness that may be attributed to solid particles. Both photographic methods are useful for flow diagnostics in low pressure systems where the flow transition range is removed from the constricting phase of the wake.
Transl. by G.G.

N69-38387# Institut Franco-Allemand de Recherches, St. Louis (France).
EXPERIMENTAL STUDY OF THE FLOW REVERSAL IN THE WAKE OF A HYPERVELOCITY SPHERICAL PROJECTILE [ETUDE EXPERIMENTALE DE LA TRANSITION DU SILLAGE D'UNE SPHERE EN VOL HYPERSONIQUE]
B. C. Jaeggy, J. Lunesu, and P. Smigielski 5 Dec. 1968 44 p refs In FRENCH; GERMAN summary
(ISL-57/68) Avail: CFSTI

Data from studies on low pressure laminar turbulent flow reversal in the wake of a hypervelocity spherical projectile are collected and evaluated. Performed calculations and comparisons point out the effects of various parameters and the validity of the Zeiberg reversal criterion is proven. This criterion can be used for all parameters and because of its inherent simplicity is universally applicable.
Transl. by G.G.

N69-38392# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
CAVITATING FLOWS
Milton S. Plesset Apr. 1969 22 p refs
(Contract N00014-67-A-0094)
(AD-688160; Rept-85-46) Avail: CFSTI CSCL 20/4

An analysis is given of the theory of the growth and collapse of vapor cavities for supercooled liquids and for superheated liquids. For the problem of the collapse of a vapor cavity particular attention is given to the theoretical effects of compressibility.
Author (TAB)

N69-38412*# IIT Research Inst., Chicago, Ill. Technology Center.
IMPROVEMENT OF LAMINAR-FLOW EQUIPMENT FOR MICROELECTRONIC APPLICATION Final Report, 1 Jun. 1967 - 31 May 1968
T. M. Rymarz 10 Mar. 1969 68 p refs
(Contract NAS12-552)
(NASA-CR-86217; IITRI-C6114-12) Avail: CFSTI CSCL 20D

Laminar flow equipment was improved for microelectronics applications, and the application of laminar flow equipment to the medical profession was studied. There are only two possible approaches to improving laminar flow benches for control of particulate contamination in laminar flow benches. Either filtration efficiency can be improved or air flow patterns can be modified. The first method was chosen and a laminar flow bench with an improved filter was constructed. Theoretical calculations were also made in order to evaluate the conditions under which contaminated room air can penetrate into the clean area of an open laminar flow bench. It was concluded that movements of personnel or objects near the open face of a bench can propel dirty air into the bench.
Author

N69-38425# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CAVITATION TUBE OF THE CENTRAL SCIENTIFIC RESEARCH, PLANNING AND DESIGN BOILER AND TURBINE INSTITUTE
K. P. Korzo et al 13 Mar. 1969 17 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. i Proektn.-Konstrukt. Inst. Kotloturbinnyi (USSR), no. 61, 1965 p 129-135
(AD-688690; FTD-MT-24-475-68) Avail: CFSTI CSCL 20/4

The reasons for the creation of the high-speed cavitation tube are given, and the basic units are described. The cavitation tube makes it possible to study (for the first time in the practice of Soviet water-turbine building) the scale effects in cavitation, the conditions for the formation and development of various forms of cavitation, and the effects of these types of cavitation (bubble, film, and detached) on the hydrodynamic characteristics of profiles.
TAB

N69-38431# Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Lab.
TURBULENCE MEASUREMENTS WITH HOT WIRES AT BNL
C. J. Lawn Apr. 1969 39 p refs
(RD/B/M-1277) Avail: CFSTI

Literature relevant to the measurement of turbulence properties in gas flow by hot wire anemometers is discussed, and the linearized constant temperature system in use for channel measurements is described. Special attention is given to possible sources of error in the measurement of Reynolds shear stress and the theoretical estimates of error are compared with results from a smooth pipe. It is concluded that at low Reynolds numbers, the present system is capable of predicting shear stress to within 3%.
Author

N69-38436*# National Aeronautics and Space Administration, Washington, D.C.
PITOT-TUBE MEASUREMENTS IN HYPERSONIC FLOWS HAVING LOW GAS DENSITIES AND HIGH TOTAL ENTHALPIES [PITOTSONDENMESSUNGEN IN HYPERGESCHWINDIGKEITSSTROEMUNGEN GERINGER GASDICHTEN UND HOHER GESAMTENTHALPIEN]
K. Kindler Sep. 1968 31 p refs Transl. into ENGLISH from a GERMAN Report
(NASA-TT-F-12335) Avail: CFSTI CSCL 20D

Measurements with cooled hemispherical and flat-faced Pitot tubes in low-density argon flows having a high total enthalpy are discussed. The results are compared with those of previous experimental and theoretical reports. Finally, an attempt is made to give a physical explanation for the deviations of Pitot-tube measurements from inviscid values in rarefied gas flows.
Author

N69-38440# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
VELOCITY MEASUREMENTS IN ROUGHENED ANNULI
C. J. Lawn and M. J. Hamlin Feb. 1969 33 p refs
(RD/B/N1278) Avail: CFSTI

Velocity measurements in two annular test sections containing ribbed surfaces are related to the wall shear stresses. These were determined by location of the zero shear stress surface with a hot

wire probe, and from the pressure gradient. Results confirm an earlier conclusion based on a roughened pipe experiment, that the flow over a ribbed surface is influenced by viscosity. The nature of this influence is obscured by the scatter in the results, thought be be due to unintentional variations in rib profile from one surface to another. A method, based on these results, of predicting friction factors is described, and conclusions are drawn as to the effect of the geometry of the test section. Author

N69-36468*# National Aeronautics and Space Administration, Washington, D.C.
THE ENTRAINMENT OF SOLIDS IN A PIPE BY A FLOW OF A VISCOUS INCOMPRESSIBLE LIQUID [UVLECHNIYE TVERDOGO TELA V TRUBE POTOKOM MEZHIMAYEMOY ZHIDKOSTI]
V. A. Lyulka et al Sep. 1969 8 p refs Transl. into ENGLISH from Zh. Vychislitelnoi Mat. i Mat. Fiz. (Moscow), v. 9, no. 1, 1969 p 238–243
(NASA-TT-F-12370) Avail: CFSTI CSCL 20D

A numerical solution of the problem of entrainment of a cylindrical body by a viscous liquid in a circular tube is given. The dimensions of the body are assumed to be commensurable with the radius of the tube. The problem is considered to be the determination of the veolcity of the inertial system of coordinates in which the solution of the corresponding boundary problem for the steady state Navier–Stokes equations yields a force equal to zero acting on the solid. Author

N69-36500# National Aerospace Lab., Tokyo (Japan).
SIMPLE FLOW CHARACTERISTICS ACROSS A STRONG SHOCK WAVE
Kenneth K. Yoshikawa Feb. 1969 5 p refs
(NAL-TR-171T) Avail: CFSTI

The gas dynamics for an entry body in very high speed flights (i.e., meteors) involves multiple layer flow and heat transfer problems: the interactions among the cold air ahead of the shock wave,the heated air behind the shock wave, and the layer of ablation gases adjacent to the body surface. Among these multiple gas layers, it is shown that the energy transfer process can be approximated as either (1) a constant density process (for the preheating zone), or (2) a constant pressure process (for shock and ablation layers). The results of these findings simplify the solution of the energy equation significantly. Author

N69-36502*# National Aeronautics and Space Administration, Washington, D.C.
ON BODIES OF ROTATION IN MACH 1 FLOW OF AN IDEAL GAS [O TELAKH URASHCHYENIYA V ZVUKOVOM POTOKE IDEAL'NOGO GAZA]
V. N. Diyesperov et al Sep. 1969 15 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i. Mat. Fiz. (Moscow), v. 9, no. 1, 1968 p 184–176
(NASA-TT-F-12369) Avail: CFSTI CSCL 20D

A solution for the velocity field of a source is presented which permits the calculation of the effect of that force. It is found that the source and the dipole both perturb a uniform Mach 1 flow ahead of a shock front to the same degree. The parameters of the flow caused by these phenomena differ only in the region behind the shock. It is assumed that far removed from the body of rotation the motion of the ideal gas is isentropic and that the flow is intersected by a low-intensity shock wave. The resulting change in the entropy is much smaller than the quantities retained by an approximation. Since a flow originating at infinity is uniform, it is irrotational everywhere under the assumed conditions. The velocity potential is then obtained by transformation from a system of Euler equations to a single partial differential equation. K.W.

N69-36544# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE COMPUTATION OF LOSSES IN THE IMPELLER OF A CENTRIFUGAL COMPRESSOR
S. N. Shkarbul 24 Feb. 1969 18 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), v. 10, no. 7, 1967 p 48–55
(AD-688089; FTD-HT-23-1053-68) Avail: CFSTI CSCL 13/7

The results are presented of the calculation of losses in centrifugal-compressor rotors using various methods previously described in literature. A comparison of the methods is made with rotor losses determined experimentally and with friction losses determined by means of boundary layer theory. Author (TAB)

N69-36557*# National Aeronautics and Space Administration, Washington, D.C.
ON SELF-SIMILAR SOLUTIONS FOR THE COLLASPE OF AN EMPTY CYLINDRICAL HOLLOW IN A GAS WITH EQUATION OF STATE p EQUALS S RHO SUP X [OB AVTOMODELNIKH RESHENIYAKH DLYA SKHLOPYVANIYA PUSTOY TSILINDRICHESKOY POLOSTI V GAZE S URAVENIVEM SOSTOYANIYA P EQUALS S RHO SUP X]
N. S. Kozin Sep. 1969 14 p ref Transl. into ENGLISH from Zh. Vychislitelnoi Mat. i Mat. Fiz. (Moscow), v. 9, no. 1, 1969 p 243–251
(NASA-TT-F-12371) Avail: CFSTI CSCL 20D

A solution to the problem of the collapse of an empty spherical hollow in a gas, as described by the equation of state $p = S_\rho x$ is given. The solution is then simplified by the fact that the invariance of the equations and boundary conditions in the original system under the similarity group G_k (where k is a parameter in the group, called the self-similarity exponent) enables reduction of the system to one of ordinary differential equations. A.C.R.

N69-36633# Kansas State Univ., Manhatten. Inst. for Design and Optimization.
AIR FLOW MODELS IN A CONFINED SPACE: A STUDY IN AGE DISTRIBUTION
Michael S. K. Chen, E. S. Lee, L. T. Fan., and C. L. Hwang May 1969 32 p refs
(Contract F44620-68-C-0020; Proj. Themis)
(AD-688238; ISDO-5; AFOSR-69-1296TR) Avail: CFSTI CSCL 13/1

The concept of age distribution was used to study the air distribution in a confined space. This concept has been used successfully in the study of mixing in chemical reactors. Several flow models based on this concept are proposed. The use of these models in design, data correlation, control, and scale-up problems are discussed. Experimental procedures for verifying the proposed models and predicting the various parameters in the models are also discussed. Author (TAB)

N69-36636# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
NONSTATIONARY HYDRODYNAMIC FLOW AND LIE'S THEOREM ON FINITE CONTINUOUS GROUPS
E. J. Post Jan. 1969 28 p refs /its Phys. and Mat. Sci. Res. Paper no. 385
(AD-688215; AFCRL-69-0014) Avail: CFSTI CSCL 20/10

The one-parameter group property of a continuous and stationary hydrodynamic flow is taken to be an intrinsic property of the flow. The specification of having the group property prevail for references with respect to which the same flow may not be stationary demands a group representation applicable to stationary as well as to nonstationary flow. A space-time realization of the group

meets that requirement. The group parameter of this realization is a domain-scalar of space-time, which is not in general identifiable with proper time, unless the flow is geodetic. The implications of a kinematics based on this group parameter instead of on proper time, is investigated in some detail, in particular, for the case where the two parameters differ; that is, nongeodetic flow.
Author (TAB)

N69-36649# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.

A NUMERICAL ANALYSIS OF PLANE COUETTE FLOW OF RAREFIED BINARY GAS MIXTURE

Kanji Abe (Japan Soc. for the Promotion of Sci.) Jul. 1969 13 p refs

(ISAS-440-Vol-34-No-7) Avail: CFSTI

The plane Couette flow problem for rarefied binary gas mixture is studied on the basis of relaxation-type kinetic model equations. The results of numerical computations for the case where the relative wall velocity $U\omega$ is small are found to be qualitatively in good agreement with results of the analysis by Weinstein both on the basis of the two-component equivalents of Grad's thirteen-moment approximations and on the basis of two-stream function method of Liu and Lees. The cases where $U\omega$ is moderate or large are also analysed on the basis of the same model equations. The velocity profiles of each species are found to indicate no appreciable separation for the case of not so large $U\omega$. The separation between each species in the number density becomes appreciable as $U\omega$ increases. The friction coefficients are found to smoothly bridge from the continuum to the free-molecule limit.
Author

N69-36650 Safety in Mines Research Establishment, Buxton (England).

MATHEMATICAL TREATMENT OF THE SHOCK WAVE PRODUCED BY THE DETONATION OF EXPLOSIVE AT THE CLOSED END OF A RIGID TUBE

W. L. Murray and J. Plant 1968 32 p refs

(SMRE-RR-257) Copyright. Avail: Issuing Activity 6s

A study is made of the propagation and decay of the shock wave produced in an ideal gas in a rigid tube by a plane detonation wave moving through a column of explosive confined at the closed end of the tube. The expansion of the products behind the detonation front is assumed to be that according to Taylor, and entropy changes in the region between the shock front and the contact surface separating the detonation products and the ideal gas are considered. Details are given of calculations (based on the method of characteristics) for a hypothetical explosive. The possibility of the development of a second shock front in the products when their ratio of specific heats is 2, and the inevitability of the development of such a shock when the ratio is 3, are discussed.
Author

N69-36652# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.

EXPERIMENTAL STUDY OF THE HYPERSONIC RAREFIED GAS FLOW PAST A FLAT PLATE AND AROUND A CYLINDER

Yasunori Kobayashi May 1969 38 p refs

(ISAS-439-Vol-34-No-8) Avail: CFSTI

Detailed flow survey around a flat plate with a sharp leading edge and a circular cylinder in the hypersonic rarefied gas flow was carried out over a wide range of the flow density. The experimental condition of the flat plate covers the range of the rarefaction parameter up to 20, and the measured results bridge the regions predictable by the strong interaction theory and by the free molecule theory. The rarefied flow around the cylinder was obtained up to the Knudsen number of 400. The so-called shoulder wave was found to exist in the region between the free molecule flow and the continuum flow. The structure of the wake measured is surprisingly similar to the one predicted by the viscous theory.
Author

N69-36655# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.

SPECTRAL ANALYSIS OF FLUCTUATIONS IN A BOUNDARY LAYER [ANALYSE SPECTRALE DES FLUCTUATIONS DANS UNE COUCH LIMITE]

Gia Ban Diep, Thanh Son Duong, Pierre Gougat, and Bernard Prunet-Foch May 1969 31 p refs In FRENCH

(Rept-69-2) Avail: CFSTI

The study of the boundary layer poses the problem of knowing the distribution, the thickness of the fluctuation, and the frequency functions. An attempt to solve this problem is made using several available methods. They are the analytical, numerical, indirect, and direct methods. Comparisons were made of the four, and it was found that the analytical method is more rapid than the others. This is needed for the examination of the frequency band. Advantages and disadvantages were also discussed for the methods. Results indicate that all of the methods used were accurate.
Transl. by E.H.W.

N69-36659# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.

SECONDARY FLOW IN A BOUNDARY LAYER

S. D. Veenhuizen and R. N. Deroney Jun. 1969 138 p refs

(Contract N00014-68-A-0493)

(AD-688926; CER68-69SDV-RNM28; THEMIS-CER-TR-3) Avail: CFSTI CSCL 20/4

The secondary flow in a developing boundary layer of a square duct is investigated experimentally. Measurements of the horizontal components of secondary flow were made for three free stream Reynolds numbers based upon the hydraulic diameter of 360,000, 720,000, and 1,400,000. Measurements of the developing boundary layer parameters and turbulence quantities in a corner were made for the intermediate Reynolds number. A criterion for two dimensionality of wind tunnel flow is examined and a correction for three dimensionality is evaluated from the experimental data.
Author (TAB)

N69-36670# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

THE IMPINGEMENT OF A CIRCULAR JET NORMAL TO A FLAT SURFACE WITH AND WITHOUT CROSS FLOW Final Technical Report, Nov. 1967-Jan. 1969

Paul E. Colin and D. Olivari Jan. 1969 59 p refs

(Contract DAJA37-68-C-0352)

(AD-688953) Avail: CFSTI CSCL 20/4

The flow field resulting from a circular jet impinging on a flat surface in a main cross-flowing stream was investigated. A cross-flowing stream produces considerable changes to the flow field of a jet impinging on a flat surface. Separation of the radial wall jet occurs along a horse-shoe shaped line with the formation of a separation bubble whose dimensions can be large compared to the jet nozzle diameter for large values of the jet to free stream velocity ratio. Because of the very high levels of turbulence encountered in the separation bubble, measurements with pressure or electrical probes were restricted to limited regions of the flow field. As a result, extensive use was made of flow visualization techniques. The results presented bring out some of the typical characteristics of the flow field investigated. An analysis is proposed to explain and predict some of these characteristics.
Author (TAB)

N69-36749# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
CALCULATION OF TRANSVERSE VELOCITIES IN THE INITIAL AND MAIN SECTIONS OF TURBULENT JETS IN A WAKE FLOW
A. S. Ginevskii 27 Mar. 1969 28 p refs Transl. into ENGLISH from Prom. Aerodinam. (USSR), no. 27, 1966 p 55–70
(Contract NOW-62-0604-c)
(AD-688287; APL-CLB-3-T-584) Avail: CFSTI CSCL 20/4

Formulas are derived and used for calculating transverse velocity profiles in the main and initial sections of a plane or axisymmetric jet in a wake flow. The formulas are based on the use of boundary-layer equations and of a continuity equation combined with a constant momentum condition. Approximate solutions are obtained with these formulas and the results of calculations are compared. A comparison of approximate and exact solutions is given for the main section of a plane and axisymmetric submerged jet. Author (TAB)

N69-36761*# Techtran Corp., Glen Burnie, Md.
ATMOSPHERIC REFRACTION AND REFLECTION OF BANGS TOWARD THE GROUND [REFRACTION ATMOSPHERIQUE ET REFLEXION AU SOL DES BANGS]
C. Thery Washington NASA Sep. 1969 19 p refs Transl. into ENGLISH from the French Presented at the AGARD Propulsion and Energetics Panel Meeting, St. Louis, France
(Contract NASw-1695)
(NASA-TT-F-12443) Avail: CFSTI CSCL 20D

An analysis of the behavior of a sonic wave in the vicinity of a totally reflecting caustic surface is presented, as applicable to sonic booms. A properties method allows wave refraction to be followed as long as flow behind the wave remains supersonic. Author

N69-36805*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF PREDICTION METHODS AND STUDIES OF RELAXATION IN HYPERSONIC TURBULENT NOZZLE-WALL BOUNDARY LAYERS
Dennis M. Bushnell, Charles B. Johnson, William D. Harvey, and William V. Feller Washington Sep. 1969 35 p refs
(NASA-TN-D-5433) Avail: CFSTI CSCL 20D

Recent turbulent boundary-layer measurements on axisymmetric nozzle walls at Mach numbers of 6, 8, and 19 are presented and compared with the predictions of two theoretical methods. One of the methods was of the integral type; the other was a finite-difference solution to the governing differential equations. The integral method gave good predictions of the data at Mach 6 and 8 and a reasonable prediction at Mach 19. Results for the finite-difference approach were available only at Mach 8, for which good agreement with data was obtained. A survey of boundary-layer data indicates that the variation of total temperature with velocity for flat-plate type of flows can be represented within the scatter of the data by the linear Crocco relation, whereas for nozzle-wall flows, this relation is generally more nearly quadratic. A finite-difference solution for the Mach 8 nozzle-wall boundary layer resulted in a quadratic-type temperature-velocity relation in the strong favorable pressure-gradient region downstream of the throat. However, near the nozzle exit the theoretical solution tended to approach the linear variation of Crocco. Apparently, the observed quadratic variation in nozzle boundary layers can be at least partly accounted for by the pressure-gradient history of the flow. Author

N69-36830*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MODIFIED METHOD OF INTEGRAL RELATIONS APPROACH TO THE BLUNT-BODY EQUILIBRIUM AIR FLOW FIELD, INCLUDING COMPARISONS WITH INVERSE SOLUTIONS
L. Bernard Garrett, John T. Suttles, and John N. Perkins (N. C. State Univ.) Washington Sep. 1969 94 p refs
(NASA-TN-D-5434) Avail: CFSTI CSCL 01A

A modified approach to the first order approximation of the method of integral relations is presented for the numerical calculation of the inviscid, adiabatic flow field around a blunt nose body traveling at hypersonic speeds. Solutions have been obtained and computed flow field data are presented for the adiabatic steady flow of a perfect gas and air in chemical equilibrium. The results obtained by the present method of solution are compared with results obtained by using inverse methods, property derivative integral relations methods, and experiment. The results indicate that the present method provides an accurate, versatile solution of the blunt body flow field, and the relative simplicity of the method should allow extension to coupled radiating flow field analyses. Author

N69-36896# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
ON THE UNIVERSAL FUNCTIONS OF A BINARY BOUNDARY LAYER (1) ANALYSIS
Ting Y Li and Mark N. Director Feb. 1969 90 p refs
(Contract N00014-67-A-0232)
(AD-688202; TR-2) Avail: CFSTI CSCL 20/4

The universal boundary layer functions, obtained for a specified value of the blowing parameter, are independent of the prescribed Mach numbers and surface temperatures. These computed data can be used to systematically study binary boundary layer behaviors under the interacting effects of surface mass transfer and prescribed pressure gradient, for a range of free stream Mach numbers and surface temperatures. Author (TAB)

N69-36911 Washington Univ., St. Louis, Mo.
DEVELOPMENT OF CONSTITUTIVE RELATIONS FOR A COLLOIDAL SUSPENSION OF ELLIPSOIDAL PARTICLES IN A TWO-DIMENSIONAL FLOW FIELD
Myrne Rodney Riley (Ph.D. Thesis) 1968 181 p
Avail: Univ. Microfilms: HC $9.40/Microfilm $3.00 Order No. 69-2443

Equations expressing the increased stress as a function of the principal strain-rate are derived for a colloidal suspension of ellipsoidal particles in a general two-dimensional flow field. These relations are obtained by transforming the behavior at the surface of N particles per unit volume aligned parallel in a flow field to a quasi-continuum where the non-isotropic behavior of the suspension is represented by the stress functions. These stress functions are then averaged for all probable orientations by statistical methods using the orientation distribution function. The results of the stress analysis for the case of Couette flow reduce to the viscosity relations derived elongated ellipsoids and spheres. Based on the reduction of the stress functions to previously derived viscosity relations, it is concluded that the behavior of a colloidal suspension of particles may be analyzed by considering the particle and the surface force distribution on the particle, and that a transformation to a quasi-continuum of the characteristic at the surface of the particle successfully produces stress relations describing the behavior of the suspension. An analysis of the orientation distribution function was made to provide greater latitude over previous work inasmuch as this analysis provides capability for computations for general two-dimensional flow fields. The

stress relations and birefringence relation were compared with the stress-optical behavior of milling-yellow dye in a Couette flow field. Dissert. Abstr.

N69-36912 Connecticut Univ., Storrs.
AN ANALYTICAL STUDY OF NON-UNIFORM FLUID FLOW IN A POROUS MEDIUM IN ASSOCIATION WITH TRANSPIRATION COOLING
James Joseph Rizza (Ph.D. Thesis) 1968 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-2173

The flow field within a structure which is porous and which also possesses a high material strength is studied. This structure can be fabricated by bonding together a porous material and a high strength material that contains a configuration of small ports. This type of structure may be used for transpiration-cooled surfaces for which a high material strength requirement exists. For this particular type of structure, the fluid is allowed to pass through the small ports in the high strength material into the porous material and is released at the surface of the porous material which is exposed to the hot gases, thus forming a thin insulating layer of coolant. Primary interest is centered about the determination of the velocity field at the exposed surface for various flow conditions within the structure. The major difficulty is that at the interface between the porous material and the high strength material a mixed boundary condition exists. The surface velocity for three distinct port configurations are developed. The type of flows considered are steady flow of an incompressible fluid and steady flow of a compressible fluid with both isothermal and adiabatic expansion. The ratio of the port spacing to the thickness of the porous material has a major effect on the velocity field. The surface velocity is evaluated for various values of this ratio for all three port configurations for the types of flows. Dissert. Abstr.

N69-36915 Princeton Univ., N.J.
EXPERIMENTAL DETERMINATION OF THERMODYNAMIC FUNCTIONS OF ARGON AT HIGH PRESSURES, IN THE FLUID PHASE AND ALONG THE MELTING CURVE IN THE SOLID PHASE
Roy Kent Crawford (Ph.D. Thesis) 1968 157 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-2734

A new experimental method and the associated apparatus for making high pressure equation of state measurements of dense fluids is described. The method involves weighing a sample of a fluid of known volume while simultaneously measuring its temperature and pressure. The method is also suitable for determining the molar volumes of the fluid and solid phases at the melting curve. Equation of state measurements were carried out for argon in the fluid phase over a temperature range from 95°K to 210°K at pressures ranging between 0.2 kilobars and 6.3 kilobars. These measurements yielded molar volumes accurate to 0.1% over this region. Measurements of the molar volumes of solid and fluid argon along the melting curve were made for melting temperatures between 95°K and 200°K. These measurements are also accurate to 0.1%. Fluid theories and models for melting are reviewed and the relevant theories are compared with the experimental data. A new model for melting is proposed based on the transition from ordered to disordered phases observed in the computer calculations for systems of hard spheres. Dissert. Abstr.

N69-36940* # National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
POWER- AND CROSS-SPECTRA AND SPACE-TIME CORRELATIONS OF SURFACE FLUCTUATING PRESSURES AT MACH NUMBERS BETWEEN 1.6 and 2.6
Wei J. Chyu and Richard D. Hanly Sep. 1969 21 p refs
(NASA-TN-D-5440) Avail: CFSTI CSCL 20D

The statistical properties of pressure fluctuations that were measured on surfaces adjacent to attached and separated turbulent boundary layers developed on an ogive cylinder and on the cylinder ahead of a 45° cone frustum were studied. Power- and cross-spectra, space-time correlations, convection velocities embracing both broad and narrow frequency bands, and coherence of the pressure field are presented. The pressure field under the attached boundary layer exhibits properties similar to those at subsonic speeds. Correlations and coherence functions showed a strong dependence on Mach number. Convection velocities are nearly constant with frequency in attached flow, but they vary greatly with frequency in separated flow. Coherence functions are significantly lower in separated flow than under attached boundary layers. Under both attached and separated boundary layers the phase-shift relationship of cospectra and quadspectra is a function of wave number $f\xi_1/U_c(f)$, where f, ξ_1, and U_c represent frequency, spatial distance, and convection velocity, respectively. Author

N69-36979# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Sciences.
TENSILE STRENGTH OF LIQUIDS
Milton S. Plesset Apr. 1969 24 p refs
(Contract N00014-67-A-0094)
(AD-688161; Rept-85-47) Avail: CFSTI CSCL 20/4

The theory of the tensile strength of a pure liquid is developed and it is shown that it predicts much larger tensile strengths than are observed. This theory is modified and extended under the supposition that liquids usually contain nuclei which are here taken to be solid particles. It is shown that the theory leads to more moderate predictions of tensile strength provided the solid particles are not wetted by the liquid. It is also shown that Brownian motion will serve as the mechanism whereby solid particles can remain in suspension in liquids. Author (TAB)

N69-37002 # Royal Netherlands Aircraft Factories Fokker, Amsterdam.
ELDO-PAS NUTATION DAMPER: EXPERIMENTS
W. H. deLeeuw 8 Aug. 1968 60 p refs
(RV-24; TR-2) Avail: CFSTI

A qualitative analysis is given of the liquid motion in a liquid nutation damper. Quantitative information about the performance of the damper was obtained from some preliminary experiments, on the basis of which the nutation damper for the PAS satellite could be selected. Some additional aspects of the damper are discussed. The measurements performed with a model fuel tank are presented. Author

N69-37010# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
TRANSIENT EXCITATION OF A LIQUID HALF-SPACE BY A DECELERATING LOAD AND THE ASSOCIATED TRANSONIC EFFECTS
Michael K. Myers and Hans H. Bleich Apr. 1969 31 p refs
(Contract Nonr-266(86))
(AD-688157; CU-1-69; TR-44; ONR-266-86-CE) Avail: CFSTI CSCL 20/4

Wave propagation from a two-dimensional expanding load on a liquid half space is considered for the case in which the fronts of the load decelerate monotonically from an initial supersonic speed. The pressure on the surface is taken to be of constant magnitude. Particular attention is paid to the pressure field near the surface during the transonic period of motion of the expanding pulse. It is found that rapid variations in the field occur near the wavefront during this period. Results are computed for the special case of a uniformly decelerating load. Author (TAB)

N69-37133# Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
NUMERICAL STUDIES IN GAS DYNAMICS Scientific Interim Report, 15 Apr. 1968 – 14 Apr. 1969
G. A. Bird 15 Apr. 1969 6 p refs
(Grant AF-AFOSR-915-67)
(AD-689287; AFOSR-69-1478TR) Avail: CFSTI CSCL 20/4

The Direct Simulation Monte Carlo Method was further developed to deal with molecules having rotational degrees of freedom. Rotational relaxation was studied for both rough sphere and weighted sphere molecules. Shock wave structure in a gas of rough sphere molecules was also investigated. Other applications of the method included: (1) Heat Transfer in the presence of a strong gravitational field. (2) The breakdown of translational equilibrium in an unsteady expansion wave. (3) The structure of a spherically imploding shock wave. (4) The reflection of a shock wave from a diffusely reflecting wall. (5) The use of computer display facilities to illustrate the velocity distribution function within a strong shock wave. Author (TAB)

N69-37166# Massachusetts Univ., Amherst. Engineering Research Inst.
AN INVESTIGATION OF VELOCITY PROFILES IN THE LAMINAR SUBLAYER WITH NON-NEWTONIAN ADDITIVES USING HIGH SPEED PHOTOMICROSCOPY Final Technical Report, Sep. 1965 – May 1969
Charles E. Carver, Jr. and Richard H. Nadolink May 1969 78 p refs
(Contract Nonr-3357(07))
(AD-689385; ERI-69-3) Avail: CFSTI CSCL 20/4

The report describes the development of a high speed photomicroscopic technique, using dark-field microscopy, for the measurement of turbulent velocity distributions in a circular pipe. The method is especially adapted to velocity measurements extremely close to a boundary, of the order of five microns. Velocities are obtained from the analysis of 16 mm film exposure with a high speed camera, due to the motion of illuminated polystyrene tracers, 1.305 microns in diameter, dispersed in distilled water and aqueous solutions of non-Newtonian additives. An electronic flash time base is used to synchronize absolute and relative motion for a permanent record on the film. The photomicroscopic method was used to determine velocity distributions of distilled water and aqueous solutions of the non-Newtonian additives Polyox-301, CMC, and Polyhall-27, flowing in a circular lucite channel 5030 microns in diameter, at a Reynolds number of 4,000. Additive concentrations of 1/100% and 1/10% by weight were used. The results for distilled water indicate excellent agreement with the postulated linear velocity distribution for flow in the laminar sublayer. Polyox-301 at both concentrations displayed a marked increase in the laminar sublayer thickness, as determined by the slope of the laminar sublayer velocity profile, while CMC and Polyhall-27 showed little deviation with distilled water. A quantitative description of the laminar sublayer structure with and without additives is also incorporated. Author (TAB)

N69-37174# Mississippi State Univ., State College. Dept. of Aerophysics and Aerospace Engineering.
AN INVESTIGATION OF THE EFFECT OF FLUID INJECTION ON THE SKIN FRICTION COEFFICIENT OF AN INCOMPRESSIBLE TURBULENT BOUNDARY LAYER
C. A. Randall, Jr. Fort Eustis, Va. Army Aviation Material Labs. Mar. 1969 38 p refs
(Contract DAAJ02-67-C-0016)
(AD-688166; RR-80; USAAVLABS-TR-69-6) Avail: CFSTI CSCL 20/4

The skin-friction reduction of an incompressible, turbulent boundary layer due to fluid injection was found in a porous pipe in the pipe Reynolds number range of 68,000 to 201,500. A reduction in C sub F of approximately 20 percent was found with fluid injection quantities of .0004. The experimental results from the porous pipe agreed with the directly measured shear results on a flat plate by Roberts and Randall and agreed reasonably well with the results of Mickley and Davis. The experimental results gave a larger reduction in skin friction with fluid injection than predicted by theoretical analyses. Author (TAB)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N69-36046# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
ON THE STATISTICAL STRUCTURE OF THE VERTICAL PROFILE OF THE COEFFICIENT OF AEROSOL EXTINCTION IN THE STRATOSPHERE [O STATISTICHESKOI STRUKTURE VERTIKALNOVO PROFILYA KOEFFITSIENTA AEROZOLNOVO OSLABLENIYA V STRATOSFERE]
L. I. Koprova Aug. 1969 10 p refs Transl. into ENGLISH from Fiz. Atmosferyi Okeana (USSR), v. 5, no. 2, 1969 p 196–200
(TR-53) Avail: CFSTI

The statistical characteristics of the field $\sigma(z)$ are investigated for altitudes from 3 to 35 km according to the data of a searchlight sounding. Author

N69-36054 Utah State Univ., Logan.
NIGHT AIRGLOW OI GREEN, CONTINUUM AND HYDROXYL EMISSIONS
Ray Owen Waddoups (Ph.D. Thesis) 1968 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-1090

Maximum OI-green emission of 14R km at 102 km; maximum continuum emission of 0.04 RA $-^{1}$km $^{-1}$ at 91 km; and maximum OH emission of 44 R/km at 97 km were observed. Simultaneous measurement of high-energy electron flux and OI-green emission showed that no significant amount of excitation resulted from high-energy electron bombardment. These measurements, together with similar reports by other investigators, were analyzed to determine the excitation mechanisms responsible for the emissions. The shapes of the observed emission-versus-altitude profiles indicated that the Chapman mechanism is the source of oxygen green emission. Seasonal fluctuations in altitude were also observed. Continuum emission-versus-altitude profile shapes showed the NO + O reaction mechanism to be the likely source of the night airglow continuum. The observed emission rate was shown to agree with the theoretical rate. Hydroxyl emission was shown to fluctuate in a complicated manner. Quenching by ozone appeared to be the probable explanation for part of the differences between emission observations. Additional studies should reveal seasonal and diurnal patterns of change. Dissert. Abstr.

N69-36064*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELD OBSERVATIONS IN HIGH BETA REGIONS OF THE MAGNETOSPHERE

M. Sugiura, T. L. Skillman, B. G. Ledley, and J. P. Heppner Aug. 1969 12 p refs Presented at the Summer Advanced Study Inst. on Earth's Particles and Fields, Santa Barbara, Calif., 4–15 Aug. 1969 Submitted for Publication
(NASA-TM-X-63645; X-612-69-359) Avail: CFSTI CSCL 04A

The distortion of the geomagnetic field in the magnetosphere is discussed on the basis of the magnetic observations by the OGO I, 3, and 5 satellites. Approximate distributions of ΔB are given in the noon and midnight sectors of the magnetosphere for magnetically quiet and slightly disturbed conditions. A sudden decrease in the magnetic field followed by irregular variations was often observed near midnight on low latitude inbound orbits of OGO 3. Following the onset of a negative bay disturbance on the ground, the magnetic field in the tail collapses near the meridional plane of the bay onset. On the dawn side of the magnetosphere, the magnetic field gradient is near zero in the equatorial region between about 11 R_E and the magnetopause. Author

N69-36083# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DEVELOPMENT OF EARTH SCIENCES IN THE USSR, VOLUME 2 Selected Articles
A. P. Vinogradov 17 Jan. 1969 452 p refs Transl. into ENGLISH from the Publ. "Razvitiye Nauk o Zemle v SSSR, Sovetskaya Nauka i Tekhnika Za 50 Let" Moscow, Izd. Nauka, 1967 p 1–96, 113–260, 270–715
(AD-685030; FTD-MT-24-291-68-Vol-2) Avail: CFSTI CSCL 8/7

Contents: Land; (Complex study of natural conditions and natural resources and development of physical and economic geography, geographical discoveries, the investigation of the relief of the terrestrial surface and the development of geomorphology, basic trends in the development of climatology, the study of glaciers and snow cover, and the development of glaciology, permafrost studies, the development of the geographical direction in hydrology, the study of soil cover and the development of pedology, the study of vegetable cover and the development of geobotany, Zoogeography, further problems of geography in the system of earth sciences and the nearest prospects of developing new scientific specializations); The ocean; (From the history of oceanology, marine meteorology, hydrology of the sea, physics of the sea, chemical oceanography, sea plankton). TAB

N69-36132# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
CARTOGRAPHIC AND GEODETIC SURVEYING REPORTS. SERIES 1: GERMAN CONTRIBUTIONS AND INFORMATION, ISSUE NO. 39 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN. REIHE 1: DEUTSCHE BEITRAEGE UND INFORMATIONEN, HEFT NR. 39]
1969 90 p refs In GERMAN; ENGLISH summaries
Avail: CFSTI

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1. WEST-EUROPEAN SATELLITE TRIANGULATION PROGRAM. THE OBSERVATION STATION KLOPPENHEIM OF THE INSTITUTE FOR APPLIED GEODESY H. Grosse p 5–18 (See N69-36133 21-13)

2. SCALE CONTROL OF VARIOUS FIRST-ORDER TRIANGLE BASE LINES IN THE GERMAN PART OF THE EUROPEAN CALIBRATION LINE OF THE SATELLITE WORLD NET TROMSOE-CATANIA (AS OF END 1967) H. Dirk p 19–24 (See N69-36134 21-13)

3. ASTRONOMICAL OBSERVATIONS BASED ON LAPLACE POINTS AS PRACTICED AT THE INSTITUTE FOR APPLIED GEODESY H. Walter p 25–52 refs (See N69-36135 21-13)

N69-36133# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
WEST-EUROPEAN SATELLITE TRIANGULATION PROGRAM. THE OBSERVATION STATION KLOPPENHEIM OF THE INSTITUTE FOR APPLIED GEODESY [WESTEUROPAEISCHES SATELLITEN-TRIANGULATIONSPROGRAMM. DIE BEOBACHTUNGSSTATION KLOPPENHEIM DES INSTITUTS FUER ANGEWANDTE GEODAESIE]
Hansdieter Grosse *In its* Cartographic and Geodetic Surv. Rept., Ser. 1, No. 39 1969 p 5–18 In GERMAN; ENGLISH summary (See N69-36132 21-13)
Avail: CFSTI

In July 1966 a new observation station for satellites was installed in Kloppenheim near Frankfurt/Main. A ballistic camera of the French Institut Geographique National was used for the observations. The camera has a focal length of 30 cm and a relative lens aperture of 1 : 4.3. In February 1968 this camera was replaced by a WILD camera BC-4. Approximately 300 usable photographs of satellites were taken during this period. The location and equipment of the station, the cameras, observation methods, instrumentation for time measurements, the photographic material, and the results of the observations are described in this report. K.W.

N69-36134# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
SCALE CONTROL OF VARIOUS FIRST-ORDER TRIANGLE BASE LINES IN THE GERMAN PART OF THE EUROPEAN CALIBRATION LINE OF THE SATELLITE WORLD NET TROMSOE-CATANIA (AS OF END 1967) [MASSSTABSKONTROLLEN VERSCHIEDENER DREIECKSSEITEN 1. ORDNUNG IM DEUTSCHEN ANTEIL DER EUROPAEISCHEN EICHLINIE DES SATELLITEN-WELTNETZES TROMSOE-CATANIA]
Hermann Dirk *In its* Cartographic and Geodetic Surv. Rept., Ser. 1, No. 39 1969 p 19–24 In GERMAN; ENGLISH summary (See N69-36122 21-13)
Avail: CFSTI

Measurements with the 2A geodimeter were started in the spring of 1967 on the European calibration line of the satellite world net. Aside from the primary triangulation sides measured during the period 1962–68 which are situated on or close to the traverse, there still remain about 12 to 15 first-order triangulation sides to be observed with the 2A geodimeter. Eight triangulation sides of the West German primary triangulation net were measured directly or by sections during 1967. Author

N69-36135# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
ASTRONOMICAL OBSERVATIONS BASED ON LAPLACE POINTS AS PRACTICED AT THE INSTITUTE FOR APPLIED GEODESY [DIE PRAXIS DER DURCH DAS INSTITUT FUER ANGEWANDTE GEODAESIE AUF LAPLACE-PUNKTEN DURCHGEFUEHRTEN ASTRONOMISCHEN BEOBACHTUNGEN]
Hellmut Walter *In its* Cartographic and Geodetic Surv. Rept., Ser. 1, No. 39 1969 p 25–52 refs In GERMAN; ENGLISH summary (See N69-36132 21-13)
Avail: CFSTI

Instruments and observation procedures are described. An AP 70 transit with a 70-mm-dia objective and a focal length of 644.5 mm was used. The special accessories for this instrument included a graduated rotating mount, Horrebow levels for latitude determinations, a set of filters, a photographic registration device for the levels, and a registration micrometer for star transport during time measurements. Additional equipment included a quartz clock with time signal oscillograph, a chronograph printer, signaling

lights, and the necessary power sources. The observations basically served to accomplish two tasks: time measurements for the longitude and azimuth determinations, and the measurements of zenith distance differences according to the Horrebow–Talcott method for the determination of latitude. The observational programs, data processing, and evaluation are discussed. Transl. by K.W.

N69-36212 Michigan Univ., Ann Arbor.
THE MAINTENANCE OF THE TIME-AVERAGED STATE OF THE ATMOSPHERE
Jacques Florian Derome (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-2306

The maintenance of standing eddies and of the axisymmetric regime is treated. The maintenance of the standing eddies is studied by means of a quasi-geostrophic, linear, steady state model of the atmosphere in which the zonal current is perturbed by the lower boundary topography and by a distribution of heat sources and sinks. After investigating some basic properties of the model atmosphere, some computations are made to determine its response to the combined forcing by the topography and by diabatic heating. The resulting perturbations are found to be in rather good agreement with the observed standing waves. The assumption concerning the existence of a single effective meridional wavelength is relaxed somewhat by considering an atmosphere bounded by walls at 30°N and 60°N. Results show that the usual practice in the long-wavelength regime of dropping the stationary electric field term from the Vlasov equation has the effect of overestimating the Landau damping when applied to the intermediate wavelength range. The effect of inhomogeneity upon the growth rates of the two-stream instability is shown to be a relative increase in the growth-rates for the smaller wavenumbers and a more pronounced relative decrease for the higher wavenumbers. Collisions are shown to depress the growth rate of this instability, in contrast to some other work reported in the literature. Dissert. Abstr.

N69-36300*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
TIDAL THEORY AND ORBITAL PERTURBATIONS Semiannual Report, 1 Dec. 1968–31 May 1969
William M. Kaula 31 May 1969 8 p refs
(Grant NGR-05-007-138)
(NASA-CR-105651; SAR-4) Avail: CFSTI CSCL 08C

Tidal waves and the perturbations for satellite orbits are investigated. Equations are solved and methods are studied to ensure stability of the solutions for models with contoured profiles. Due to large errors, new methods must be found for truncation series before progress can continue. Also examined are the effects of tides on the inclination of the moon's orbit close to the earth. Measuring devices and rules were devised to approximate the orbital perturbation effects. Results indicate differences occur at different heights of the spectrum. This is believed to be caused by the sensitivity of the different instruments to different parts of the spectrum. E.H.W.

N69-36424# Ferrara Univ. (Italy).
GEOPHYSICAL CONTRIBUTIONS WITH A GEOLOGICAL APPENDIX [CONTRIBUTI GEOFISICI CON APPENDICI GEOLOGICHE]
C. Morelli, R. Dal Cin, E. Semenza, and P. Leonardi (Osservatorio Geofis. Sper., Trieste, Italy) 1968 79 p refs In ITALIAN; ENGLISH summary
Avail: CFSTI

A gravity and magnetic survey was accomplished in the Dolomite region, with Worden gravimeters, calibrated on the Italian calibration base. Errors are discussed, and the results corrected for diurnal variation and drift are presented in maps. Also, a qualitative geological interpretation of the residual gravity anomalies is given. These interpretations permit some deductions of a general nature, the most significant being the existence of a series of zones of low value and strong anamolies. Author

N69-36441# National Academy of Sciences – National Research Council, Washington, D.C. World Data Center A Coordination Office
WORLD DATA CENTER A CATALOGUE OF DATA ON SOLAR-TERRESTRIAL PHYSICS: SOLAR AND INTERPLANETARY PHENOMENA, IONOSPHERIC PHENOMENA, FLARE-ASSOCIATED EVENTS, GEOMAGNETIC PHENOMENA, AURORA, COSMIC RAYS, AIRGLOW, 1 JULY 1957 – 28 FEBRUARY 1969
Jun. 1969 177 p refs Supported by NSF
Avail: CFSTI

All the data associated with the various disciplines of solar-terrestrial physics received by the World Data Center-A (established in the U.S.A.), or known to be available are listed in this catalogue. Geophysical data on solar and interplanetary phenomena, ionospheric, flare-associated events, geomagnetic phenomena, auroras, cosmic rays, airglow, and a miscellaneous section which covers noctilucent clouds, meteorological rockets, and ozone are in this collection. M.H.E.

N69-36443# Institut Franco-Allemand de Recherches, St. Louis (France).
BALLOON SONDE MEASUREMENT OF DIFFUSE SKY BRIGHTNESS, PART 2 [MESSUNG DES DIFFUSEN HIMMELSLICHTES MITTELS BALLONEN (2 TEIL)
F. Roessler and D. Bock 19 Aug. 1968 43 p refs In GERMAN; FRENCH summary
(ISL-T-27/68) Avail: CFSTI

The results of three ascents up to 25 km from Stuttgart, Germany, are presented and compared. Construction and operation of the instruments have been described in a previous report, and only the spectral sensitivity of the instruments and the filter combinations are briefly discussed here. The results show maxima for the aerosol layer and a latitudinal dependence of the maximum altitude of the aerosol layer. This maximum altitude drops off with the tropopause toward the pole, thus indicating that it is of terrestrial origin. Improvements in the experiments are suggested. Transl. by K.W.

N69-36448*# Volt Information Sciences, Inc., Washington, D.C.
THE ROLE OF MINOR ATMOSPHERE ADMIXTURES IN THE ABSORPTION OF INFRARED RADIATION
B. P. Kozyrev et al Greenbelt, Md. NASA Goddard Space Flight Center 28 Aug. 1969 10 p refs Translated into ENGLISH from Fiz. Atmosfery i Okeana (Moscow), v. 5, no. 7, 1969 p 738–744
(Contract NAS5-12487)
(NASA-CR-105718; ST-AM-RAD-10861) Avail: CFSTI CSCL 04A

The role of minor atmospheric gas admixtures in the absorption of infrared radiation is discussed from various points of view. The unavailability of practical methods of computations is emphasized. The transparency of minor atmospheric admixtures is plotted as a function of W/W_0 and the errors of calculation are evaluated. It is concluded that minor atmospheric components play a significant role in the attenuation of infrared radiation. Author

N69-36449*# Volt Information Sciences, Inc., Washington, D.C.
CAUSES OF MOTION OF GEOGRAPHIC POLES AND NATURE OF WORLD GEOPHYSICAL FIELDS
A. V. Dolitskiy Greenbelt, Md. NASA Goddard Space Flight Center 16 Sept. 1969 9 p refs Transl. into ENGLISH from Dok. Akad. Nauk SSSR (Moscow), v. 187, no. 3, 1969 p 32–635
(Contract NAS5-12487)
(NASA-CR-105720; ST-ES-GM-10868) Avail: CFSTI CSCL 08F

The causes of motion of geographic poles invoking various data concerning the planes along which the displacements of the interface core-mantle take place are discussed. The relative shifts of separate parts of the earth's crust layer are examined in the light of the Guttenberg waveguide theory. The trajectories of motion of the North geographic and magnetic poles are shown in a chart in the form of spiral-shaped curves. Describing some of the singularities of the earth's magnetic field, a way to reconstruct it was found through various geological epochs. Finally, the motions of the earth's crust and the shape of the geoid are defined, invoking the Pavoni chart. Author

N69-36509 World Meteorological Organization, Geneva (Switzerland).
PRACTICAL SOIL MOISTURE PROBLEMS IN AGRICULTURE
G. Stanhill, ed. 1968 83 p refs Presented at the WMO Comm. for Agr. Meteorol. on Pract. Soil Moisture Probl. in Agr., Manila, Nov. 1967
(WMO-235-TP-128; TN-97) Copyright. Avail: Issuing Activity

This report of the working group of the WMO commission for agricultural meteorology discusses various techniques of soil moisture assessment, particularly direct gravimetric sampling, electrical resistance, tensiometer, and neutron-scattering methods. Meteorological aids to the efficient use of water for irrigation, including various methods of estimating open water evaporation and evapotranspiration from crops are also discussed. Author (ESRO)

N69-36515# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
CARTOGRAPHIC AND GEODETIC SURVEYING REPORTS, SERIES 1: GERMAN CONTRIBUTIONS AND INFORMATION, ISSUE NO. 38 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN. REIHE 1: DEUTSCHE BEITRAEGE UND INFORMATIONEN]
1968 91 p refs In GERMAN; partly summarized in ENGLISH
Avail: CFSTI

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1. COMPARISON OF THE ECONOMY OF TERRESTRIAL AND PHOTOGRAMMETRICAL METHODS R. Foerstner p 5–17 refs (See N69-36516 21-13)

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3. CONFORMAL TRANSFORMATIONS OF ONE MAP PROJECTION TO ANOTHER USING DIFFERENTIATED INTERPOLATION. REMARK ON THE REMAINING TERM G. B. Lauf and F. Young p 26–47 refs (See N69-36518 21-13)

4. POSSIBILITIES FOR ADJUSTING THE DISTORTIONS IN VACUUM FORMING OF PLASTIC RELIEF MAPS H. Muehle 48–75 ref (See N69-36519 21-13)

N69-36516# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMPARISON OF THE ECONOMY OF TERRESTRIAL AND PHOTOGRAMMETRICAL METHODS [VERGLEICH DER WIRTSCHAFTLICHKEIT VON TERRESTRISCHEN MIT PHOTOGRAMMETRISCHEN METHODEN]
Rudolf Foerstner *In its* Cartographic and Geodetic Surv. Rept., Ser. 1, Issue No. 38 1968 p 5–17 refs In GERMAN; ENGLISH summary (See N69-36515 21-13)
Avail: CFSTI

It is assumed that we use photogrammetry for a task in the field of surveying. But we refrain from a comprehensive comparison of purely terrestrial methods with photogrammetric methods. We solely deal with the determination of control points and the complementary terrestrial work. The economy of both these tasks depends to a large extent on the picture scale. For this reason we first investigate, how the picture scale is influenced by accuracy, interpretation, plotting instrument and map size. The cost of a terrestrial determination of control points is compared with the cost of an aerotriangulation. The ratio of the expenses for the determination of a control point and the expenses for the plotting of a model in aerotriangulation is decisive for the choice of the procedure to be used. From the given formulae we can easily conclude, in which cases a strip or block triangulation is more favorable than the terrestrial determination of control points. The extent of complementary terrestrial work varies considerably and frequently depends on local conditions. In this paper the task is only indicated in short. In particular it is recommended to publish more frequently reliable data obtained in practical work. Author

N69-36517# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
CALCULATION OF THE RIGHT-ANGLED CADASTRAL COORDINATES IN THAILAND [DIE BERECHNUNG DER RECHTWINKLIGEN KOORDINATEN DES THAILAENDISCHEN KATASTERS]
Dieter Ehlert *In its* Cartographic and Geodetic Surv. Rept., Ser. 1, Issue No. 38 1968 p 18–25 In GERMAN; ENGLISH summary (See N69-36515 21-13)
Avail: CFSTI

Within the scope of a project of technical aid for developing countries the formulae have been examined on which the calculation of the cadastral coordinates of Thailand has been based. The author presents a proposition for the calculation of table values. Examples of calculation are supplementary to the essay. Author

N69-36518# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
CONFORMAL TRANSFORMATIONS OF ONE MAP PROJECTION TO ANOTHER USING DIFFERENTIATED INTERPOLATION. REMARK ON THE REMAINING TERM [KONFORME TRANSFORMATIONEN VON EINER KARTENPROJEKTION AUF DIE ANDERE UNTER VERWENDUNG EINER INTERPOLATION MIT GETEILTER DIFFERENZ. ANMERKUNG UEBER DAS RESTGLIED]
G. B. Lauf and F. Young *In its* Cartographic and Geodetic Surv. Rept., Ser. 1, Issue No. 38 1968 p 26–41 refs In GERMAN (See N69-36515 21-13)
Avail: CFSTI

Conformal transformations from one cartographic projection to another use the theory of differential interpolation to transfer geographical coordinates of arbitrary points first onto the one and then onto the other projection. The obtained coordinate sets are then used to form a table of complex numbers and to calculate the interpolation differentials. By transforming the geographical coordinates of any new point onto the first system and subsequent interpolation by complex number table gives the corresponding coordinates of the second system. Results are then compared with those coordinates formed through direct transformation of geographic coordinates into the second system. Transl. by G.G.

N69-36519# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
POSSIBILITIES FOR ADJUSTING THE DISTORTIONS IN VACUUM FORMING OF PLASTIC RELIEF MAPS [MOEGLICHKEITEN DER AUSGLEICHUNG VON VERZERRUNGEN BEI DER VAKUUMVERFORMUNG VON KUNSTSTOFF-KARTENRELIEFS]
Helmut Muehle *In its* Cartographic and Geodetic Surv. Rept., Ser. 1, Issue No. 38 1968 p 48–75 ref In GERMAN (See N69-36515 21-13)
Avail: CFSTI

The elongation behavior of plastic foils during vacuum forming for relief mapping was tested on truncated cone and hemispheric test models. Test foil areas were marked by millimeter nets and the elongation after cupping was determined by counting the number of millimeter fields in the area of the mapped surface. Deformed foils were reformed with the help of exactly contoured plastic relief sheets as long as the foil was in its thermoelastic temperature region. Transl. by G.G.

N69-36526# Panametrics Inc., Waltham, Mass.
A ROCKET BORNE AIR DENSITY MEASUREMENT SYSTEM UTILIZING ELECTRON-BREMSSTRAHLUNG-CALIBRATION AND FLIGHT Final Report, 24 Feb. 1966–28 Feb. 1969
Bach Sellers and Frederick A. Hanser 28 Feb. 1969 34 p refs (Contract AF 19(628)-5943)
(AD-688280; AFCRL-69-0165) Avail: CFSTI CSCL 4/1

Calibration and flight of rocket systems for air density measurement in the range 100-200 km altitude are described. The systems use detection of bremsstrahlung from an electron beam to achieve this measurement. No density measurements were obtained because of failure of failure of the electron guns. Monitors in the payload indicate that, in two successive flights, current from the guns ceased almost immediately after they were opened. Possible causes for this are considered, and it is shown that cathode poisoning is consistent with all of the monitored data. Conclusions and recommendations for further work are given. Author (TAB)

N69-36568# Akademiya Nauk URSR, Kiev.
DEEP CRUSTAL STRUCTURE
1967 112 p refs In RUSSIAN; ENGLISH summaries *Its* Geophys. Commun., Issue 20
Avail: CFSTI

CONTENTS:

1. CRUSTAL THICKNESS, STRUCTURE, AND PHASE CHARACTER OF THE MOHOROVICHICH DISCONTINUITY I. Sh. Rakhimova and M. N. Golovatch p 1–22 refs (See N69-36569 21-13)

2. GEOTHERMAL CONDITIONS IN THE CRIMEA T. S. Lebedev, V. V. Gordiyenko, and R. I. Kutas p 23–28 refs (See N69-36570 21-13)

3. MAIN FEATURES OF DEEP STRUCTURE OF NORTHERN BLACK SEA AND WESTERN CAUCASUS AREAS I. A. Garkalenko, M. R. Pustilnikov, V. B. Sollogub, A. V. Chekunov, and M. V. Chirvinskaya p 41–49 refs (See N69-36571 21-13)

4. PALEOMAGNETISM AND STABILITY OF CONTINENTS O. M. Rusakov p 41–49 refs (See N69-36572 21-13)

5. GEOLOGICAL AND GEOPHYSICAL INDICATIONS OF DEEP FRACTURES OF CERTAIN PLATFORM-TYPE REGIONS G. T. Sobakar p 50–65 refs (See N69-36573 21-13)

6. GEOTECTONIC FEATURES OF THE NORTHWESTERN BLACK SEA AREA DURING PALEOGENE A. V. Chekunov p 66–72 refs (See N69-36574 21-13)

7. EXPERIMENTAL INVESTIGATIONS OF ELASTIC WAVE VELOCITIES AT HYDROSTATIC PRESSURE UP TO 500 kg/sq-cm ON MAGMATIC ROCK SAMPLES FROM THE UKRAINE T. S. Lebedev and D. V. Komlets p 73–97 refs (See N69-36575 21-13)

8. THE NATURE OF MAGNETIC ANOMALIES OF THE TRANSCARPATHIAN INNER DEPRESSION (ACCORDING TO DATA ON MAGNETIC PROPERTIES OF ROCKS) M. G. Gnilko, N. P. Mikhailova, and I. V. Gapak p 97–107 refs (See N69-36576 21-13)

N69-36569# Akademiya Nauk URSR, Kiev.
CRUSTAL THICKNESS, STRUCTURE, AND PHASE CHARACTER OF THE MOHOROVICHICH DISCONTINUITY
I. Sh. Rakhimova and M. N. Golovatch *In its* Deep Crustal Struct. 1967 p 1–22 refs In RUSSIAN; ENGLISH summary (See N69-36568 21-13)
Avail: CFSTI

Theoreticle investigations resulted in establishing an interrelation between the values of thermoconductivity coefficients of crustal layers, a heat-radiating part of the mantle, and the crustal thickness. It is shown that the precision of calculating the basaltic layer thickness with a theoretical formula allows for a variation range of the thermoconductivity coefficients for the sedimentary layer (K_1) and the heat-radiating mantle (K_4) with certain thickness of the sendimentary and granitic layers. A conclusion is drawn on the existence of a horizontal non-uniformity in distribution of the thermoconductivity coefficients K1 and K4. Relationships were established between the basaltic layer thickness and the total thickness of the earth's crust as well as between the sedimentary and granitic layer thicknesses. These relationships differ and are associated with the choice of the thermoconductivity coefficients for the sedimentary layer and the heat-radiating upper mantle; i.e., with the sign and value of the difference between the thermoconductivity coefficients of the heat-radiating mantle and the sedimentary layer. Author

N69-36570# Akademiya Nauk URSR, Kiev.
GEOTHERMAL CONDITIONS IN THE CRIMEA
T. S. Lebedev, V. V. Gordiyenko, and R. I. Kutas *In its* Deep Crustal Struct. 1967 p 23–28 refs In RUSSIAN; ENGLISH summary (See N69-36568 21-13)
Avail: CFSTI

Generalized data of temperature determinations in deep boreholes are considered. Thermal conductivity measurements of rocks in the laboratory are presented. A scheme of distribution of the geothermal gradient for the Crimea is compiled (reduced gradient for the Maikop deposits). A great intricacy of the thermal field in the region is pointed out. Heat flow varies more than three times. Some general regularities of the geothermal regime are distinguished. Several large zones differing by intensity of the thermal field are traced. The greatest heat flow and geothermal gradient values are characteristic of the central part of the peninsula, whose upraised consolidated basement is complicated by a block system. Extreme values of heat flow result also from the peculiarities of the sedimentary cover structures and hydrogeological factors. Author

N69-36571# Akademiya Nauk URSR, Kiev.
MAIN FEATURES OF DEEP STRUCTURE OF NORTHERN BLACK SEA AND WESTERN CAUCASUS AREAS
I. A. Garkalenko, M. R. Pustilnikov, V. B. Sollogub, A. V. Chekunov, and M. V. Chirvinskaya *In its* Deep Crustal Struct. 1967 p 29–40 refs In RUSSIAN; ENGLISH summary (See N69-36568 21-13)
Avail: CFSTI

The deep structure of the northern Black Sea and western Caucasus areas has a distinct block character. Deep and other large fractures specify a geotectonic zoning of the territory, subdividing the earth's crust into blocks with considerably differing structure history, and regime of tectonic movements. The fractures are classified into two main systems of a different age: a submeridional system whose origination and principal manifestations date back to Precambrian time and a younger sub-latitudinal (late Proterozoic era and younger). Formation of the sub-latitudinal fracture system marked a sharp alteration of the tectonic pattern of the northern Black Sea and Caucasus areas during late Proterozoic era. Older sub-meridianal fractures are translucent through the younger sub-latitudinal structural scheme having a certain influence on the geotectonic zoning, distribution of facies, folding, etc; thus displaying an exceptional stability and persistence. The upper portion of the sedimentary cover, in contrast to deeper horizons, is generally characterized by a smooth tectonics. Author

N69-36572# Akademiya Nauk URSR, Kiev.
PALOMAGNETISM AND STABILITY OF CONTINENTS
O. M. Rusakov *In its* Deep Crustal Struct. 1967 refs p 41–49 In RUSSIAN; ENGLISH summary (See N69-36568 21-13)
Avail: CFSTI

Data on the remanent magnetization of rocks sampled from different continents are presented. The data are not consistent with the paleomagnetic theory of the continental drift, even if a dipole nature of the geomagnetic field is admitted a priori. It is suggested that in North America and Australia ancient continental anomalies existed when the field in Europe followed the dipole law. Therefore, the European paleomagnetic pole is considered a reference one. A scatter of the paleomagnetic poles might result from the influence of the ancient continental anomalies. The following evidence supports the above hypothesis: (1) the intersection of the ancient azimuth lines of the North American, Australian, Asiatic, and European continents virtually in one point, which is coincident with a reference pole; (2) the coincidence of the reference and paleoclimatic poles; (3) the dependence of the distance from the poles of different continents to the reference pole upon the value of the difference between the paleomagnetic and paleoclimatic latitudes, the latter difference being caused by the ancient anomalies. Author

N69-36573# Akademiya Nauk URSR, Kiev.
GEOLOGICAL AND GEOPHYSICAL INDICATIONS OF DEEP FRACTURES OF CERTAIN PLATFORM-TYPE REGIONS
G. T. Sobakar *In its* Deep Crustal Struct. 1967 p 50–65 refs In RUSSIAN; ENGLISH summary (See N69-36568 21-13)
Avail: CFSTI

The role of fractures in the development and structure of the earth's crust is elucidated. It is established that the fractures control crustal movements and specify such geological phenomena as magmatism, metamorphism, and ore formation. Studies of magmatic complexes suggest that the fractures play a decisive role not only in the distribution of magmatic masses, but in the origination of magmatic chambers as well. In the zones of fractures and crumples of the crust the processes of metamorphism display a greater intensity. Author

N69-36574# Akademiya Nauk URSR, Kiev.
GEOTECTONIC FEATURES OF THE NORTHWESTERN BLACK SEA AREA DURING PALEOGENE
A. V. Chekunov *In its* Deep Crustal Struct. 1967 p 66–72 refs In RUSSIAN; ENGLISH summary (See N69-36568 21-13)
Avail: CFSTI

Using marine reflection seismic and drilling data, the peculiarities of the geotectonic development of the area during paleogenic times are analyzed. Schemes of equal thicknesses of the Paleocene–Eocene and Maikop deposits have been compiled. The earth's crust of the northwestern part of the Black Sea underwent a considerable subsidence during the above mentioned period. The depression opened to the south, towards a deep-water sea basin. Having a general sub-meridianal trend, the depression separated the Crimean and Dobrudja structures during Oligocene and Neogene. For Paleocene–Eocene time, the presence of a relative sub-latitudinal elevation can be suggested extending from the Kilian uplift, north of Dobrudja, to the Simferopol–Evpatoria upheaval in the plain Crimea. The submeridional trend of the northwestern Black Sea depression was specified to a large extent by an influence of the ancient tectonic zones and deep fractures, renovated during post–Riphean time. The formation of a downwarp in the northwestern sea area was genetically related to the formation of the Black Sea depression. Author

N69-36575# Akademiya Nauk URSR, Kiev.
EXPERIMENTAL INVESTIGATIONS OF ELASTIC WAVE VELOCITIES AT HYDROSTATIC PRESSURE UP TO 5000 kg/sq-cm ON MAGMATIC ROCK SAMPLES FROM THE UKRAINE
T. S. Lebedev and D. V. Korniets *In its* Deep Crustal Struct. 1967 p 73–97 refs In RUSSIAN; ENGLISH summary (See N69-36568 21-13)
Avail: CFSTI

A hydraulic apparatus of high hydrostatic pressure with a delayed–pulse oscillator enables us to determine velocity values at different pressures with a precision of an order of 1% was used. Velocity measurements were conducted on samples taken from lumps of rocks in three or two mutually perpendicular directions. It was possible to take into account a velocity anisotropy at varying pressures. For a number of the rock lumps, velocities were investigated on individual samples. The character of variation of longitudinal wave velocities versus pressure (depth) was established, as well as that of the material composition of igneous rocks of the northwestern part of the Ukrainian shield and mountainous Crimea. Author

N69-36576# Akademiya Nauk URSR, Kiev.
THE NATURE OF MAGNETIC ANOMALIES OF THE TRANSCARPATHIAN INNER DEPRESSION (ACCORDING TO DATA ON MAGNETIC PROPERTIES OF ROCKS)
M. G. Gnilko, N. P. Mikhailova, and I. V. Gapak *In its* Deep Crustal Struct. 1967 p 97–107 refs In RUSSIAN; ENGLISH summary (See N69-36568 21-13)
Avail: CFSTI

The magnetic field of the Transcarpathian inner depression is extremely intricate. Here anomalies of various configurations, dimensions, and ratios of negative and positive elements are observed. In the plain part of the Ichep–Mukachevo depression on a low-intensity magnetic background large anomalous units of conjugated positive and negative anomalies with an intensity up to ±1000–2000 γ are distinguished. Within the Vygorlat–Gutino volcanic ridge, a mosaic field is revealed comprising numerous small anomalies with large gradients and intensity of ±2000 γ. Using a genetic morphology criterion, all the anomalies are classified into five types in terms of definite properties of the petrographic composition, structure, and conditions of formation of the disturbing bodies. The classification is vital for a geological interpretation of the intricate magnetic field anomalies of the Transcarpathian depression. The nature of the magnetic anomalies is discussed on the basis of data yielded by studies of magnetic properties of rocks, as well as according to geologic mapping and deep drillings performed during recent years. Author

N69-36595 # Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
[LENGTH DETERMINATIONS AND CONNECTION OBSERVATIONS AT VARIOUS POINTS IN THE GERMAN GEODETIC TRIANGULATION NET, SERIES B, NO. 144] [LAENGENBESTIMMUNGEN UND ANSCHLUSSBEOBACHTUNGEN AN VERSCHIEDENEN PUNKTEN IM DEUTSCHEN GEODAETISCHEN DREIECKSNETZ, REIHE B, NO. 144]
Karl-Wilhelm Schrick 1968 64 p refs In GERMAN; ENGLISH summaries
Avail: CFSTI

CONTENTS:

1. ASTRONOMICAL LONGITUDE DETERMINATION 1964 AT THE PRIMARY TRIANGULATION POINTS NIEDERREIFENBERG, ONSTMETTINGEN, AND MUNICH WITH CONNECTION TO HAMBURG AND NEUCHATEL K.-W. Schrick p 5–21 refs (See N69-36596 21-13)

2. ASTRONOMICAL DETERMINATION OF THE LONGITUDE DIFFERENCE OF TWO REFERENCE STATIONS IN HAMBURG K.-W. Schrick p 23–26 refs (See N69-36597 21-13)

3. THE LONGITUDE OF THE PRIMARY TRIANGULATION POINT NIEDERREIFENBERG BASED ON CONNECTIVE OBSERVATIONS OVER SEVERAL YEARS K.-W. Schrick p 29–33 refs (See N69-36598 21-13)

N69-36596 # Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
ASTRONOMICAL LONGITUDE DETERMINATION 1964 AT THE PRIMARY TRIANGULATION POINTS NIEDERREIFENBERG, ONSTMETTINGEN, AND MUNICH WITH CONNECTION TO HAMBURG AND NEUCHATEL [ASTRONOMISCHE LAENGENBESTIMMUNG 1964 AUF DEN HAUPTDREIECKSPUNKTEN NIEDERREIFENBERG, ONSTMETTINGEN, UND MUENCHEN MIT ANSCHLUSS AN HAMBURG UND NEUCHATEL]
Karl-Wilhelm Schrick *In its* Length Determinations and Connection Observations at Various Points in the Ger. Geodetic Triangulation Net, Ser. B, No. 144 1968 p 5–21 refs In GERMAN; ENGLISH summary (See N69-36595 21-13)
Avail: CFSTI

The longitudes of three future reference stations had been determined by observations with a transit instrument. Main reference points were the world longitude stations of the photographic zenith tubes at Hamburg and Neuchatel. — The results show a dependence from right ascension and thus confirm the existence of a systematic error of the Fourth Fundamental Catalogue found by other authors. Author

N69-36597 # Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
ASTRONOMICAL DETERMINATION OF THE LONGITUDE DIFFERENCE OF TWO REFERENCE STATIONS IN HAMBURG [ASTRONOMISCHE BESTIMMUNG DER LAENGENDIFFERENZ ZWEIER REFERENZSTATIONEN IN HAMBURG]
Karl-Wilhelm Schrick *In its* Length Determinations and Connection Observations at Various Points in the Ger. Geodetic Triangulation Net, Ser. B, No. 144 1968 p 23–28 refs In GERMAN; ENGLISH summary (See N69-36595 21-13)
Avail: CFSTI

The difference of conventional longitudes of the old world longitude station near the Deutsches Hydrographisches Institut and the new Photographic Zenith Tube Observatory does not agree well with the difference of geodetic longitudes. The geodetic value is confirmed by observations with a transit instrument on both stations. Author

N69-36598 # Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE LONGITUDE OF THE PRIMARY TRIANGULATION POINT NIEDERREIFENBERG BASED ON CONNECTIVE OBSERVATIONS OVER SEVERAL YEARS [DIE LAENGE DES HAUPTDREIECKSPUNKTES NIEDERREIFENBERG AUS MEHRJAEHRIGEN ANSCHLUSSBEOBACHTUNGEN]
Karl-Wilhelm Schrick *In its* Length Determinations and Connection Observations at Various Points in the Ger. Geodetic Triangulation Net, Ser. B, No. 144 1968 p 29–33 refs In GERMAN; ENGLISH summary (See N69-36595 21-13)
Avail: CFSTI

The future longitude reference station of Niederreifenberg has been connected with points of the world longitude net by repeated sets of observations with a transit instrument. Author

N69-36665 # Joint Publications Research Service, Washington, D.C.
OCEANOGRAPHY
In its Soviet-Bloc Res. in Geophys., Astron., and Space, No. 207 1 Jul. 1969 p 15–18 refs (See N69-36662 21-30)
Avail: CFSTI

Statistical methods are recommended to improve oceanographic manuals by providing objective evaluations of their regimes. Scientific abstracts of oceanographic studies cover the areas of oceanic circulation, sea surface effects and wave interactions, oceanic temperatures, and hydrochemical and hydrological characteristics of seas bordering the Soviet Union. G.G.

N69-36666 # Joint Publications Research Service, Washington, D.C.
TERRESTRIAL GEOPHYSICS
In its Soviet-Bloc Res. in Geophys., Astron., and Space, No. 207 1 Jul. 1969 p 19–28 refs (See N69-36662 21-30)
Avail: CFSTI

Devices and methods for measuring gravity, magnetic fields, and seismic effects on land and in water are studied. The use of floating platforms for offshore drilling operations is advocated. Abstracts of scientific articles cover seismic studies on the Asian earth crust and for detection of powerful explosions. G.G.

N69-36714 # Duntley (S. Q.), La Jolla, Calif.
DIRECTIONAL REFLECTANCE OF ATMOSPHERIC PATHS OF SIGHT
Seibert Q. Duntley May 1969 19 p refs Sponsored in part by USAF
(Contract NObs-90337)
(AD-688265; Rept-69-1) Avail: CFSTI CSCL 4/1

The contrast reducing properties of any path of sight inclined downward through the atmosphere can be specified by a single dimensionless number analogous to a reflectance and called the directional reflectance of the path of sight R^*. The contrast transmittance of the path depends solely upon the ratio of the directional path reflectance to the inherent directional reflectance of the background. Previously published optical atmospheric data derived from in-flight measurements have been used to produce tables of R^* for two clear-weather conditions. A simple nomograph and numerical examples are included. TAB

N69-36808# Air Force Cambridge Research Labs., Bedford, Mass.
TURBULENT ATMOSPHERIC PARAMETERS DETERMINED FROM RADIO METEOR TRAILS
Samuel P. Zimmerman Apr. 1969 21 p refs *Its* Environ. Res. Papers No. 300
(AD-688808; AFCRL-69-0162) Avail: CFSTI CSCL 4/1

The application of turbulence theory to atmospheric structure revealed by radio meteor trails clearly demonstrates that Batchelor and Obhukoffs structure function for isotropic turbulence explains some of the observed relations. From these measurements, parameters such as the rate of viscous dissipation, the eddy intensity of the scales up to k within the isotropic range, the local eddy Reynolds number describing the turbulence up to a scale k, and turbulent diffusion coefficient up to scale k, are determined. Also, an estimate of the rate at which turbulence extracts wind energy from the diurnal tide is given. The results of the parametric study suggest very strongly that the universal range of the turbulent spectrum, in the upper atmosphere, contains little or no energy extending into the inertial subrange, but lies for the most part near the viscous (high wavenumber) region. Author (TAB)

N69-36816# Akademiya Nauk URSR, Kiev.
PHYSICAL PROPERTIES OF CRUSTAL SUBSTANCE
1967 126 p refs In RUSSIAN; ENGLISH summaries *Its* Geophys. Commun., Issue 21
Avail: CFSTI

CONTENTS:

1. PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF MAGMATIC FORMATIONS IN THE CENTRAL PART OF MOUNTAINOUS CRIMEA, PART 2 T. S. Lebedev and Y. P. Orovetsky p 3–26 refs (See N69-36817 21-13)

2. EQUIPMENT FOR MEASURING ELASTIC WAVE VELOCITIES ON ROCK SAMPLES V. I. Shapoval and V. A. Korchin p 27–36 refs (See N69-36818 21-14)

3. TRANSISTORIZED THERMOMETER FOR TEMPERATURE MEASUREMENTS IN BORE HOLES V. V. Gordiyenko and R. I. Kutas p 37–38 refs (See N69-36819 21-14)

4. PRECISION OF ELASTIC WAVE VELOCITY DETERMINATIONS ON ROCKS AT HIGH PRESURES D. V. Korniets p 39–45 refs (See N69-36820 21-13)

5. PHYSICAL PROPERTIES OF SOME MAGMATIC ROCKS OF TRANSCARPATHIA T. S. Lebedev and N. F. Poznanskaya p 46–55 refs (See N69-36821 21-13)

6. TRANSCARPATHIAN EFFUSIVES AS OBJECTS OF PALEMAGNETIC INVESTIGATIONS N. P. Mikhailova, A. M. Glevasskaya, and M. K. Gnilko p 56–63 refs (See N69-36822 21-13)

7. MAGNETIC CLEANING OF UKRAINIAN LOWER PALEOZOIC BASALTS N. P. Mikhailova p 64–72 refs (See N69-36823 21-13)

8. PALEOMAGNETISM OF LATE TERTIARY AND QUATERNARY SEDIMENTS OF UKRAINIAN SSR A. N. Tretyak p 73–81 refs (See N69-36824 21-13)

9. MAGNETIZATION OF UKRAINIAN SHIELD GRANITOIDS B. Y. Savenko and A. M. Glevasskaya p 82–93 refs (See N69-36825 21-13)

10. PALEOMAGNETIC FIELD CONFIGURATION DURING TRIASSIC PERIOD O. M. Rusakov p 94–108 refs (See N69-36826 21-13)

11. EFFECT OF HEATING ON SEDIMENTARY ROCK MAGNETIZATION O. M. Rusakov and A. N. Tretyak p 109–115 refs (See N69-36827 21-13)

12. AGE OF THE MOST ANCIENT SEDIMENTARY DEPOSITS OF THE DNIESTER RIVER AREA E. B. Clevassky, V. S. Zelka-Novatsky, O. M. Rusakov, and O. N. Tretyak p 116–121 refs (See N69-36828 21-13)

N69-36817# Akademiya Nauk URSR, Kiev.
PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF MAGMATIC FORMATIONS IN THE CENTRAL PART OF MOUNTAINOUS CRIMEA, PART 2
T. S. Lebedev and Y. P. Orovetsky *In its* Phys. Properties of Crustal Substances 1967 p 3–26 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

The most pronounced manifestations of magmatic activity, associated with the zones of the sub-meridional Krivoy Rog – Samsun and the sublatitudinal foothill Crimea – Caucasus deep fractures are generally compared with the central part of mountainous Crimea. The peculiarities of distribution and regularities of variation of density (specific weight) were studied as well as that of magnetic susceptibility, remanent magnetization, velocity of the elastic longitudinal wave propagation, resistivity, and dielectric constants of the igneous formations in the above zones. The magnetic formations of the deep fracture zones differ by their physical properties and are characterized by petrochemical inhomogeneities. The rocks of the Krivoy Rog – Samsun deep fracture have greater mean density and lower magnetization. They are less basic and more diversified petrographically than the rocks of the foothill Crimea – Caucasus fracture zone. In general, the density of the central mountain Crimea igneous rocks increases with basicity and grain size. The critical parameter values of the magnetic formations of both zones result principally from the increased ferromagnetic content in them, the pecularities of chemical and thermal magnetization, and the possible effect of high-power lightning charges. Author

N69-36820# Akademiya Nauk URSR, Kiev.
PRECISION OF ELASTIC WAVE VELOCITY DETERMINATIONS ON ROCKS AT HIGH PRESSURES
D. V. Korniets *In its* Phys. Properties of Crustal Substances 1967 p 39–45 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

The precision of velocity determinations at high pressures by means of different devices and equipment is discussed. Utilization of equipment with a delayed pulse oscillator makes it possible to investigate elastic wave propagation velocities on rocks at high pressures with a precision up to 1%. Author

N69-36821# Akademiya Nauk URSR, Kiev.
PHYSICAL PROPERTIES OF SOME MAGMATIC ROCKS OF TRANSCARPATHIA
T. S. Lebedev and N. F. Poznanskaya *In its* Phys. Properties of Crustal Substances 1967 p 46–55 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

The density and magnetic susceptibility of the igneous rocks of the area increase with the basicity of the rocks. Classification of these rocks into petro-density and petromagnetic groups is indicative of certain uniqueness of their material composition, peculiarities of their origin, and age relationships. Younger andesite-basalts of the Buzhora series of the Vygorlat – Gutin ridge are less magneitc than the similar rocks of the Gutin series. The density of the andesite in both groups is characterized by the analogous ratio of values. The genesis peculiarities and the effect of the metasomatosis processes are manifested in the distribution of physical properties of the liparites and tuffs of the Vygorlat – Gutin ridge, Beregowo, and Kosin-Byegan highland areas. The rocks of the hypabyssal intrusions of the Vygorlat-Gutin and the Rakhov massive possess higher densities and magnetization as compared to that of the effusive rocks. According to their physical properties only the tuffs of the basic and acid lavas are clearly distinguished

within the tuffogenic complex. Critical values of the specific resistivity of some types of the Transcarpathian igneous rocks are presented. Author

N69-36822 # Akademiya Nauk URSR, Kiev.
TRANSCARPATHIAN EFFUSIVES AS OBJECTS OF PALEOMAGNETIC INVESTIGATIONS
N. P. Mikhailova, A. M. Glevasskaya, and M. K. Gnilko *In its* Phys. Properties of Crustal Substances 1967 p 56–63 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

Data are presented on the magnetic properties of the Neogene and Cretaceous-Paleogene volcanogenic formations of Soviet Transcarpathia. Results of preliminary studies of the remanent magnetization directions of the effusives are analysed; normal polarization of the overwhelming majority of the Neogene effusives gives rise to doubts as to their Upper Pliocene age. The question is raised about the necessity of serious investigations aimed at ascertaining the nature of magnetization of the Sarmatian liparites. Primary results of the magnetic stability studies of the Transcarpathian Neogene effusives are elucidated. On the basis of thermomagnetic data, the composition of the titano-magnetics is determined and the rock varieties distinguished which had undergone secondary heating. Author

N69-36823 # Akademiya Nauk URSR, Kiev.
MAGNETIC CLEANING OF UKRAINIAN LOWER PALEOZOIC BASALTS
N. P. Mikhailova *In its* Phys. Properties of Crustal Substances 1967 p 64–72 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

The natural remanent magnetization of basalts with a homogeneous titanium-magnetite content has been found to remain stable after heating in zero field over the temperature range of 20 to 200°C. Heating above this temperature causes ferromagnetic decomposition. Decomposition of the homogeneous titanomagnetic accompanied by the magnetite emanation is recorded in the zero field as a sharp increase of the values x and I_n and is corroborated by the results of mineralogical investigations and thermoanalysis. Author

N69-36824 # Akademiya Nauk URSR, Kiev.
PALEOMAGNETISM OF LATE TERTIARY AND QUATERNARY SEDIMENTS OF UKRAINIAN SSR
A. N. Tretyak *In its* Phys. Properties of Crustal Substances 1967 p 73–81 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

The results of the paleomagnetic studies of late tertiary and quaternary sediments of the Ukrainian SSR are presented. The last reversal of the paleomagnetic field is stated to have occurred during early Kuyalnik times. It is shown that during the investigated period of time the earth's magnetic poles had not suffered any significant displacements. Author

N69-36825 # Akademiya Nauk URSR, Kiev.
MAGNETIZATION OF UKRAINIAN SHIELD GRANITOIDS
B. Y. Sevenko and A. M. Glevasskaya *In its* Phys. Properties of Crustal Substances 1967 p 82–93 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

Primary results are outlined for laboratory magnetic stability studies of Ukrainian shield granitoids. On the basis of the stability parameters as well as correlation of different remanent magnetization types, an attempt is made to evaluate the temperature of granite ferromagnetic mineral formation. Data on the role of primary and secondary ferromagnetics in the origination of different magnetization types of the analyzed rocks are also presented. Author

N69-36826 # Akademiya Nauk URSR, Kiev.
PALEOMAGNETIC FIELD CONFIGURATION DURING TRIASSIC PERIOD
O. M. Rusakov *In its* Phys. Properties of Crustal Substances 1967 p 94–108 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

A method of quantitative analysis of paleomagnetic and paleoclimatic data is considered. Empirical dipole formulae were derived which approximate the theoretical dipole formula with a precision of 2 to 3°. A systematic disagreement is revealed between the paleomagnetic and paleoclimatic latitudes in North America and Australia. This fact is thought to be conditioned by the influence of the ancient continental anomalies coinciding territorially with the present anomalies observed on these continents. The discrepancy of the paleomagnetic pole positions appears to have been caused by the superimposition of anomalous fields upon the axial dipole field. Author

N69-36827 # Akademiya Nauk URSR, Kiev.
EFFECT OF HEATING ON SEDIMENTARY ROCK MAGNETIZATION
O. M. Rusakov and A. N. Tretyak *In its* Phys. Properties of Crustal Substances 1967 p 109–115 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

Results are given on thermal cleaning of sedimentary rocks. It is shown that by heating sedimentary rock samples up to 130 to 170° not only a marked increase of compactness of the natural remanent magnetization is achieved, but also a distinct improvement occurs in the agreement of the empirical distribution with the theoretical one. At the same time the unstable secondary magnetization vanishes. Author

N69-36828 # Akademiya Nauk URSR, Kiev.
AGE OF THE MOST ANCIENT SEDIMENTARY DEPOSITS OF THE DNIESTER RIVER AREA
E. B. Clevassky, V. S. Zaika-Novatsky, O. M. Rusakov, and O. N. Tretyak *In its* Phys. Properties of Crustal Substances 1967 p 116–121 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

According to paleomagnetic data, the age of the most ancient sedimentary rocks of the Dniester River area were determined as Proterozoic. Comparison of the virtual pole positions on the rocks shows good consistency with determinations for Africa and North America, where the absolute age of the rocks corresponds to 1300 million years. A preliminary scheme is compiled of the paleomagnetic subdivision of the most ancient sedimentary complexes in the Dniester River area. Author

N69-36951 # Akademiya Nauk URSR, Kiev.
GEOPHYSICAL COMMUNICATIONS, ISSUE 22

1967 120 p refs In RUSSIAN; ENGLISH summaries
Avail: CFSTI

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7. INTERPRETATION OF HODOGRAPHS OF REFLECTED WAVES BY THE METHOD OF EQUIDISTANT POINTS O. M. Kharitonov p 50–53 (See N69-36958 21-13)

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9. MULTIPLE REFLECTION OF WAVES IN THE CRIMEAN PLAIN E. K. Lossovsky p 60–74 refs (See N69-36960 21-13)

10. SIGNIFICANCE OF STRATUM VELOCITIES FOR CHEMOGENIC FORMATIONS IN THE DNIEPER-DONETS DEPRESSION E. P. Puzdrovsky p 75–80 refs (See N69-36961 21-13)

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13. SOLUTION OF INVERSE PROBLEM OF GRAVITATION PROSPECTING FOR GROUPS OF PERTURBING BODIES E. G. Bulakh p 91–97 refs (See N69-36964 21-13)

14. ELECTROINTEGRATOR FOR INTERPRETATION OF GRAVITY ANOMALIES V. M. Mendelutsa p 98–101 refs (See N69-36965 21-13)

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16. EFFECT OF A HEMISPHERICAL INHOMOGENEITY OF ELECTRICAL RESISTIVITY ON RESULTS OF ELECTRICAL SOUNDING V. A. Balash p 109–112 refs (See N69-36967 21-09)

17. DISSECTION OF CARBONATE SECTIONS OF CRIMEA USING GEOPHYSICAL DATA D. E. Kovalenko and N. Y. Zaikovsky p 113–120 refs (See N69-36968 21-13)

N69-36952# Akademiya Nauk URSR, Kiev.
DETERMINATION OF THE ELEMENTS OF CLOSE EARTHQUAKES BY DIRECT WAVES
S. V. Yevseyev *In its* Geophys. Commun., Issue 22 1967 p 5–12 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

A description is given of two methods of determining the coordinates of the epicenter, the focal depth h and the time of beginning of the earthquake t_0, when the moments of arrival of the direct waves are known at four stations or more. With the analytical method, equations are written for each group of three stations, and the system, the solution of which gives the epicenter coordinates depending on the velocity of waves. The equation of the epicentrals (5) is then compiled. Using the moments of arrival of waves, a second equation of the epicentrals (7) may be derived. The joint solution of (7) and (5) gives the sought for coordinates of the epicenter. The values h and t_0 are found. A graphic method for finding the hypocentral distance and the epicenter is also presented.
Author

N69-36953# Akademiya Nauk URSR, Kiev.
USE OF APPLIED GEOPHYSICS METHODS FOR OCEAN STUDY
R. M. Demenitskaya, A. M. Gorodnitsky, M. M. Kazansky, E. V. Kvartalynov, E. M. Litvinov et al *In its* Geophys. Commun., Issue 22 1967 p 13–21 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

The technique of logging is proposed for the solution of the study of the mass of water and its variability. An extensive set of geophysics methods is described for the spatial tracing of the variability of a number of physico-chemical parameters.
Author

N69-36954# Akademiya Nauk URSR, Kiev.
ON THE CONNECTION BETWEEN THE QUANTITY OF RECEIVED INFORMATION AND MEASUREMENT PRECISION
A. E. Kulinkovich *In its* Geophys. Commun., Issue 22 1967 p 22–28 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

Formulas are derived connecting the quantity of information with measurement precision in the case when the latter depends on the measured magnitude. The proposed formulas are essential for calculating the bulk of information obtained in geophysical studies.
Author

N69-36955# Akademiya Nauk URSR, Kiev.
PRECISION OF SEISMIC VELOCITY MEASUREMENTS IN BOREHOLES
V. P. Rudnitsky *In its* Geophys. Commun., Issue 22 1967 p 29–35 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

Problems of the precision and procedure of seismic velocity measurements on small bases are described, and the results of measurements in one borehole are presented.
Author

N69-36956# Akademiya Nauk URSR, Kiev.
APPLYING SYNTHETIC SEISMOGRAMS TO THE STUDY OF THE SPECTRAL PROPERTIES OF MULTILAYER MEDIA
E. K. Lossovsky *In its* Geophys. Commun., Issue 22 1967 p 36–40 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

A method is proposed for applying synthetic seismograms to the study of the possibility of spectral-selective weakening of the noise background due to multiple wave reflection in a multilayer medium.
Author

N69-36957# Akademiya Nauk URSR, Kiev.
SOME FEATURES OF THE WAVE PICTURE IN MEDIA WITH SHARP VELOCITY DIFFERENTIATION

A. Y. Dyachkova and N. L. Chobotova *In its* Geophys. Commun., Issue 22 1967 p 41–49 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

The amplitude curves of waves (including multiple ones) observed over a thick bed of granite in water were investigated. It is shown that the amplitude curve of the reflected wave has a maximum beyond the second critical point in the interference region of the waves P_{11} and $P_{11}S_2P_1$; the position of the maximum is determined by the length of the interference zone of these waves. It is also shown that in the case of a sharp velocity differentiation the intensity of waves $P_1S_2P_1$ considerably exceeds that of the longitudinal leading wave P_{121} and is commensurate with the intensity of the reflected wave. Author

N69-36958# Akademiya Nauk URSR, Kiev.
INTERPRETATION OF HODOGRAPHS OF REFLECTED WAVES BY THE METHOD OF EQUIDISTANT POINTS
O. M. Kharitonov *In its* Geophys. Commun., Issue 22 1967 p 50–53 In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

A method is proposed for determining the parameters of a stratified medium based on the straightening of hodographs of reflected waves. The method permits exclusion of the effect of interpretation of reflected waves on the values of the parameters being determined. Author

N69-36959# Akademiya Nauk URSR, Kiev.
IMPROVEMENTS TO EQUIPMENT FOR CONTROLLED DIRECTIONAL RECEPTION OF SEISMIC WAVES
F. A. Leshchuk *In its* Geophys. Commun., Issue 22 1967 p 54–59 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

Some improvements of commercial-type controlled directional reception equipment are reported. The recording rate has been modified, as well as the system of tape fixing and the time break circuit. Author

N69-36960# Akademiya Nauk URSR, Kiev.
MULTIPLE REFLECTION OF WAVES IN THE CRIMEAN PLAIN
E. K. Lossovsky *In its* Geophys. Commun., Issue 22 1967 p 60–74 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

A description is given of the results of a study of the formation of multiple reflection waves in two areas of the Crimean Plain. The possibility of using synthetic seismograms based on electric logging data for studying the mechanism of this formation is demonstrated. Author

N69-36961# Akademiya Nauk URSR, Kiev.
SIGNIFICANCE OF STRATUM VELOCITIES FOR CHEMOGENIC FORMATIONS IN THE DNIEPER DONETS DEPRESSION
E. P. Puzdrovsky *In its* Geophys. Commun., Issue 22 1967 p 75–80 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

Results are presented of a reinterpretation of seismic logging data from 42 wells which opened up chemogenic deposits. Using the values of the stratum velocities, the hemogenic sedimentary deposits are divided into two groups: deposits of salt, and of gypsums, anhydrites, and dolomites. A conclusion is drawn on the necessity for making allowances when constructing seismic sections, because the mean values of the stratum velocities of chemogenic deposits are not constant in area and depend on the ratio in the section of the thicknesses of salt, anhydrites, and dolomites. Author

N69-36962# Akademiya Nauk URSR, Kiev.
METHOD OF EQUAL RAY PARAMETERS
O. M. Kharitonov *In its* Geophys. Commun., Issue 22 1967 p 81–84 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

A method is proposed for determining the types of multiple reflected waves by their hodographs. Hodograph points remote from the explosion point but characterized by equal values of the ray parameters are used. Author

N69-36963# Dnepropetrovsk F. A. Artem Mining Inst. (Ukrainin SSR).
ALLOWANCE FOR ROUGHNESS OF PROSPECTING HOLE WALLS DURING GRAVITATIONAL MEASUREMENTS
A. A. Yunkov and I. V. Vdovin *In* Akad. Nauk URSR Geophys. Commun., Issue 22 1967 p 85–90 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

A method is described allowing for roughness of prospecting hole walls on measuring Δg, V_{xz}, V_{yz}, V_{xy}, and V_Δ. This method was used to calculate the length of the rings describing the given roughness in the prospecting hole. The intervals at which allowance must be made for roughness are determined from the calculated results. Author

N69-36964# Akademiya Nauk URSR, Kiev.
SOLUTION OF INVERSE PROBLEM OF GRAVITATION PROSPECTING FOR GROUPS OF PERTURBING BODIES
E. G. Bulakh *In its* Geophys. Commun., Issue 22 1967 p 91–97 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

A gravity anomaly due to a group of spherical perturbing bodies is considered. The inverse problem is solved by the method of most rapid drop. The interpretation procedure is illustrated by an example. Author

N69-36965# Akademiya Nauk URSR, Kiev.
ELECTROINTEGRATOR FOR INTERPRETATION OF GRAVITY ANOMALIES
V. M. Mendelutsa *In its* Geophys. Commun., Issue 22 1967 p 98–101 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

The electrointegrator is designed for tentative estimation of the coordinates of the center of gravity and mass of perturbing two-dimensional bodies of any inhomogeneous density by gravitational curves. The determination is carried out automatically without any subjective influences of the interpreter. Author

N69-36966# Akademiya Nauk URSR, Kiev.
REPRESENTATIVE PROCEDURES FOR ELECTRICAL PROSPECTING FOR WATER IN UKRAINIAN SSR

B. A. Geman *In its* Geophys. Commun., Issue 22 1967 p 102–108 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

Conditions are specified for applying electrical prospecting when searching for water based on the electrical and geological characteristics of rocks. Methodic principles of carrying out field researches and interpretation under different geological conditions are clarified. Author

N69-36968# Akademiya Nauk URSR, Kiev.
DISSECTION OF CARBONATE SECTIONS OF CRIMEA USING GEOPHYSICAL DATA
D. E. Kovalenko and N. Y. Zaikovsky *In its* Geophys. Commun., Issue 22 1967 p 113–120 refs In RUSSIAN; ENGLISH summary (See N69-36951 21-13)
Avail: CFSTI

Interpretations of geophysical prospecting data are considered, with the aim of determining porous, cavernous, and fissure traps in carbonate sections of the Paleogene and Upper Cretaceous. Author

N69-37021# Kansas Univ., Lawrence. Center for Research.
ARTIC ICE TYPE IDENTIFICATION BY RADAR
J. W. Rouse, Jr. Aug. 1968 35 p refs
(Contract Nonr-3998(02))
(AD-688936; CRES-TR-121-1) Avail: CFSTI CSCL 8/12

The pack ice in the Arctic Ocean was the subject of a special remote sensing mission conducted jointly by the National Aeronautics and Space Administration, Navy Oceanographic Office, U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), the Arctic Institute of North America, and the University of Kansas. One of the most significant results of the experiment was verification of the ability, under these conditions, of a 2.25 cm wavelength radar scatterometer to identify ice types. This article presents the results of the radar experiment, and analyzes the data to determine the characteristics of radar backscatter from various Arctic ice types. Author (TAB)

N69-37026*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VARIATIONS IN ELECTRIC FIELDS FROM POLAR ORBITING SATELLITES
N. C. Maynard and J. P. Heppner Aug. 1969 15 p refs Presented at the Summer Advanced Study Inst., Earth's Particles and Fields, 1969, Santa Barbara, Calif., 4–15 Aug. 1969 Submitted for publication
(NASA-TM-X-63657; X-612-69-374) Avail: CFSTI CSCL 04A

The electric fields in the ionosphere and magnetosphere were investigated by using long antennas on rockets to study spatial variations. The characteristics of the electric field are defined by OVI-10 data on spatial irregularities and waves in the ELF–VLF regime. The electric field shown is one of a small scale irregularity structure superimposed on the irregular dc field seen in auroral latitudes. The magnitude of these north–south directed fields is in good agreement with rocket results from barium clouds. F.O.S.

N69-37036# Texas A&M Univ., College Station. Dept. of Oceanography.
THE EQUATORIAL UNDERCURRENT, THE SOUTH EQUATORIAL - COUNTERCURRENT, AND THEIR EXTENSIONS IN THE SOUTH PACIFIC OCEAN EAST OF THE GALAPAGOS ISLANDS DURING FEBRUARY - MARCH 1967
Warren B. White May 1969 85 p refs
(Contract Nonr-2119(04))
(AD-689364; A/M-REF-69-4T) Avail: CFSTI CSCL 8/3

During February and March 1967, oceanographic observations taken by the R/V ALAMINOS east of the Galapagos Islands and north of 15 degrees S covered the region more completely than previous cruises. The Equatorial Undercurrent was present as two branches, one north and the other south of the equator. This study deals with the circulation and water in the region south of the equator. They are studied by means of vertical sections, station curves, and distributions of properties on isanosteric surfaces from 120 to 280 cl/t. At selected locations volume transports are calculated. Author (TAB)

N69-37128# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
INVESTIGATION OF THE ELECTRICAL AND MECHANICAL INTERACTIONS OF A TOWED SEISMIC ARRAY USED FOR SUBBOTTOM SEDIMENT PROFILING OF THE OCEAN FLOOR
William E. Woodward, Donald S. Blomquist, and John J. Gilheany Jun. 1969 47 p refs
(Contract N00014-67-A-0377)
(AD-689368; Rept-69-3) Avail: CFSTI CSCL 8/7

The construction of and experimentation with two seismic hydrophone arrays differing in their electrical and mechanical configurations is described. The first array was a duplicate of one built and used by C. Windisch of Lamont Geological Observatory. The second was similar in construction but included several design differences which were based on a detailed analysis of the noise detected by a towed hydrophone array. Both theoretical and at-sea experimental comparisons of the operation of the two arrays were made to determine what effect the different electro-mechanical parameters had on their signal-to-noise ratios. Results show that the design features of the second array, including the use of low noise electrical cable, zero drive signal conditioning system, and nylon towing line, provided signal-to-noise ratio increase of not less than 9 dB over that of the Lamont duplicate array for various towing speeds. Author (TAB)

N69-37141# Akademiya Nauk URSR, Kiev.
GEOPHYSICAL COMMUNICATIONS, ISSUE 24
1968 97 p refs In RUSSIAN; ENGLISH summaries
Avail: CFSTI

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2. CHANGES IN SEDIMENTARY ROCK MAGNETIZATION UPON HEATING A. N. Tretyak and O. M. Rousakhov p 12–22 refs (See N69-37143 21-13)

3. THERMOMAGNETIC CLEANING OF CRYSTALLINE ROCK N. P. Mikhailova p 23–31 refs (See N69-37144 21-13)

4. A TECHNIQUE FOR STUDYING THE VELOCITY MEASUREMENTS AT HIGH PRESSURES USING AN ACOUSTICAL DELAY LINE D. V. Korniets p 32–38 refs (See N69-37145 21-13)

5. STOCHASTIC RELATIONS OF SOME PHYSICAL PARAMETERS OF TRANCARPATHIAN EFFUSIVE ROCKS T. S. Lebedev and N. F. Poznanskaya p 39–45 refs (See N69-37146 21-13)

6. DETERMINATION OF CLAYINESS OF ROCKS FROM THE DATA FURNISHED BY THE GAMMA METHOD AND POTENTIALS OF SPONTANEOUS POLARIZATION I. A. Kapkanshchikova p 46–50 refs (See N69-37147 21-13)

7. ZONING OF THE GREAT DON BASIN ACCORDING TO PHYSICAL PROPERTIES DATA I. A. Garkalenko p 51–60 refs (See N69-37148 21-13)

8. A TECHNIQUE OF STUDYING THERMAL PROPERTIES OF ROCKS AND CALCULATING HEATFLOW VALUES IN THE CRIMEA T. S. Lebedev, B. Ya. Savenko, and D. V. Korniets p 61–72 refs (See N69-37149 21-33)

9. ORIGIN OF NATURAL REMANENT MAGNETIZATION OF LATE TERTIARY AND QUATERNARY DEPOSITS OF UKRAINIAN SSR A. N. Tretyak p 73–77 refs (See N69-37150 21-13)

10. PHYSICAL PROPERTIES OF KRIVY ROG ROCKS N. I. Baklanov and V. V. Baklanova (Ukrgeofizrazvedka) p 78–85 refs (See N69-37151 21-13)

11. PHYSICAL PROPERTIES OF LOWER BOOG ROCKS F. I. Manilov and Yu. P. Solomatin (Min. of Geol., USSR) p 86–94 refs (See N69-37152 21-13)

N69-37142# Akademiya Nauk URSR, Kiev.
THE EFFECT OF HIGH HYDROSTATIC PRESSURE ON MAGNETIC PROPERTIES OF IGNEOUS ROCKS
T. S. Lebedev, B. Ya. Savenko, and D. V. Korniets *In its* Geophys. Commun., Issue 24 1968 p 5–11 refs In RUSSIAN; ENGLISH summary (See N69-37140 21-13)
Avail: CFSTI

The results of studying the hydrostatic pressure effect up to 5000 kg/cm^2 on the magnetic susceptibility of rocks are presented. An investigation was carried out of the direction and parameters of stability of granite, gabbro, and labradorite samples with different remanent magnetization: natural, ideal, partial, thermoremanent, and saturation. As a result of the pressure effect, a considerable decrease in the value of remanent magnetization occurs (by 51% on the average). The magnetic susceptibility at the same time does not undergo any appreciable variations. The rate of decrease in the remanent magnetization upon application of pressure differs for various types of rocks. This phenomenon is believed to be associated with the ferromagnetism predominant in the rock and the type of magnetization inherent in the rock. The effect of pressure on the value of thermo-remanent magnetization is practically negligible. The pressure destroys 20 to 22% of the original magnetization when partial and ideal magnetization types are concerned. The pressure causes an insignificant deflection of the remanent magnetization direction. Author

N69-37143# Akademiya Nauk URSR, Kiev.
CHANGES IN SEDIMENTARY ROCK MAGNETIZATION UPON HEATING
A. N. Tretyak and O. M. Roussakov *In its* Geophys. Commun., Issue 24 1968 p 12–22 refs In RUSSIAN; ENGLISH summary (See N69-37141 21-13)
Avail: CFSTI

Physical principles, a technique of thermal cleaning of sedimentary rocks, methods of selecting optimal heating temperatures, and problems concerning the estimation of efficiency of removing unstable magnetization are discussed. Thermal cleaning is shown to be the only method modelling the processes resulting in the origination of I_n, but, so far as heating is effected in a zero field, I_n is destroyed instead of being produced. An analysis is presented dealing with possible transformations of hydrous ferric oxides, the most widespread sedimentary ferromagnetic minerals (which show the least stability to the heating). It is proved that magnetically significant changes in such ferromagnetics occur after their unstable magnetization is removed. Emphasis is placed on the simplicity, workability, and efficiency of the method of thermal cleaning in the sedimentary rock studies. Author

N69-37144# Akademiya Nauk URSR, Kiev.
THERMOMAGNETIC CLEANING OF CRYSTALLINE ROCK
N. P. Mikhailova *In its* Geophys. Commun., Issue 24 1968 p 23–31 refs In RUSSIAN; ENGLISH summary (See N69-37141 20-13)
Avail: CFSTI

A technique of thermomagnetic cleaning for identifying the stable magnetization of crystalline rocks of different petrographic composition and age is discussed. Anomalous instances of variation of the magnetic susceptibility, resulting from the heating of rocks in a compensated magnetic field of the earth, are examined, and the degree of the effect of the above phenomenon on the direction and magnitude of the natural remanent magnetization is determined. The increase in x across a temperature range of 150° to 250°C, due to the phase transition magnetite-maghemite, as well as the decrease in x upon heating to above 400°C (the result of the martitization) affect neither the magnitude nor the direction of In. In some rocks with a homogeneous titano-magnetite content, upon heating up to above 200°C, a decay of the ferromagnetic is observed, which rules out the possibility of their utilization for paleomagnetic studies. The origin of the natural R- and N-magnetized liparites, basalts, and dacites of the Transcarpathian area and some proterozoic crystalline rocks of the Ukrainian shield is discussed in terms of the results of the thermomagnetic cleaning. Author

N69-37145# Akademiya Nauk URSR, Kiev.
A TECHNIQUE FOR STUDYING THE VELOCITY MEASUREMENTS AT HIGH PRESSURES USING AN ACOUSTICAL DELAY LINE
D. V. Korniets *In its* Geophys. Commun., Issue 24 1968 p 32–38 refs In RUSSIAN; ENGLISH summary (See N69-37141 21-13)
Avail: CFSTI

A velocity measurement method, using a time-delay line, makes it possible to carry out investigations at high pressures with a relative root-mean square error of 0.5%. The design of the time-delay line, with transformer oil as an acoustic medium, is simple, reliable, and convenient, making it also possible to space the sensors with a high precision. A piezoelectric sensor with a thin diaphragm enables various piezoelements in form of plates with electroconductive coating to be used for ultrasonic studies. Author

N69-37146# Akademiya Nauk URSR, Kiev.
STOCHASTIC RELATIONS OF SOME PHYSICAL PARAMETERS OF TRANSCARPATHIAN EFFUSIVE ROCKS
T. S. Lebedev and N. F. Poznanskaya *In its* Geophys. Commun., Issue 24 1968 p 39–45 refs In RUSSIAN; ENGLISH summary (See N69-37141 21-13)
Avail: CFSTI

A general statistical analysis of physical properties of the Transcarpathian effusives was carried out. The next stage of the investigations involves studying the correlation relationships between some of the parameters. Considering the relationships between density, magnetic susceptibility, and remanent magnetization a general factor specifying the values of the above parameters is alterations in the rock material composition. The occasional factors may be porosity, mode of occurrence, and formation of rocks, etc. Stochastic relationships between density and magnetic parameters of liparites of the Beregovo highland area as well as that of the basic rocks of the Vygorlat–Gutin ridge in the Transcarpathian area are discussed. Empiric formulas of the regression equations and correlation characteristics have been obtained which are used for clarifying the genesis of liparite domes, identifying the changes in physical properties of rocks in the zones of deep faults, and studying the nature of the reversed magnetization of the effusives. Author

N69-37147# Akademiya Nauk URSR, Kiev.
DETERMINATION OF CLAYINESS OF ROCKS FROM THE

DATA FURNISHED BY THE GAMMA METHOD AND POTENTIALS OF SPONTANEOUS POLARIZATION
I. A. Kapkanshchikova *In its* Geophys. Commun., Issue 24 1968 p 46–50 refs In RUSSIAN; ENGLISH summary (See N69-37141 21-13)
Avail: CFSTI

The problem of the qualitative determination of clay content of Carpathian foredeep inner zone paleogenic rocks is considered. Results of a combined processing of the data furnished by the methods of spontaneous polarization potentials and natural gamma-radiation were used. Author

N69-37148# Akademiya Nauk URSR, Kiev.
ZONING OF THE GREAT ON BASIN ACCORDING TO PHYSICAL PROPERTIES DATA
I. A. Gerkalenko *In its* Geophys. Commun., Issue 24 1968 p 51–60 refs In RUSSIAN; ENGLISH summary (See N69-37141 21-13)
Avail: CFSTI

Zoning of the Great Don Basin has been accomplished in terms of the variation of electrical properties of rocks and coals, taking into account the geologico-geophysical peculiarities of each area under study. Author

N69-37150# Akademiya Nauk URSR, Kiev.
ORIGIN OF NATURAL REMANENT MAGNETIZATION OF LATE TERTIARY AND QUATERNARY DEPOSITS OF UKRAINIAN SSR
A. N. Tretyak *In its* Geophys. Commun., Issue 24 1968 p 73–77 refs In RUSSIAN; ENGLISH summary (See N69-37141 21-13)
Avail: CFSTI

Data concerning the formation of sedimentary iron minerals as well as the results of differential thermal and mineralogical studies of tertiary and quaternary rocks, widespread in the Ukrainian SSR, are analyzed. The origin of the natural remanent magnetization of the rocks can be termed as orientationally-chemical. Author

N69-37151# Akademiya Nauk URSR, Kiev.
PHYSICAL PROPERTIES ON KRIVY ROG ROCKS
N. I. Baklanov (Ukrgeofizrazvedka) and V. V. Baklanova (Ukrgeofizrazvedka) *In its* Geophys. Commun., Issue 24 1968 p 78–85 refs In RUSSIAN; ENGLISH summary (See N69-37141 21-13)
Avail: CFSTI

Results are presented of the analysis and generalization of the physical properties of the rocks of the Krivoy Rog ore body and the adjacent areas. The generalization is based on statistical classification in the form of interval distribution gradations. It was carried out according to the mineral composition and stratigraphic horizons. As a result of statistical processing of a great number of determinations of physical properties of rocks, mean values have been calculated for the density, magnetic susceptibility, and electrical resistivity. The possibility of rock differentiation in the region by these physical parameters has been ascertained. The experimental rocks of the same mineral composition and designation, but related to different complexes of the stratigraphic scheme, have very close mean values of physical parameters. Author

N69-37152# Akademiya Nauk URSR, Kiev.
PHYSICAL PROPERTIES OF LOWER BOOG ROCKS
F. I. Manilov (Min. of Geol., USSR) and Yu. P. Solomatin (Min. of Geol., USSR) *In its* Geophys. Commun., Issue 24 1968 p 86–94 refs In RUSSIAN; ENGLISH summary (See N69-37141 21-13)
Avail: CFSTI

Mapping of the precambrian petrographic varieties in this area is proved feasible by combined geologico-geophysical investigations. The need for wide utilization of physical characteristics for a more objective investigation of rocks is stressed. Author

N69-37167# University Coll., Nairobi (Kenya). Dept. of Physics.
IONOSPHERIC RESEARCH USING SATELLITES Annual Summary Report, 7 Oct. 1967 – 6 Oct. 1968
Arthur W. Hunter and Raymond F. Kelleher Nov. 1968 40 p refs
(Contract AF 61(052)-909)
(AD-689399; ASR-3; AFCRL-69-0270) Avail: CFSTI CSCL 4/1

An account is given of the analysis of satellite transmissions recorded at Nairobi, Addis Ababa and Dar es Salaam. Work has been concentrated on the latitude and diurnal variation of total electron content (satellites BE-B and Canary Bird), the latitude variation of scintillation occurrence (BE-B and BE-C), and the height and size of irregularities (San Marco). Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N69-36052 Princeton Univ., N.J.
THE MEASUREMENT OF THE ATMOSPHERIC WIND PROFILE
Robert Frank Stengel (Ph.D. Thesis) 1968 274 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.65 Order No. 69-2563

A system for measuring a vertical profile of atmospheric wind employing a lifting wind sensor and radar tracking was analyzed in light of wind field characteristics and resolution requirements. The lifting sensor is capable of responding to small wind disturbances while falling at high velocity. Current instrumentation radars are not capable of following the small scale motions which result, although modifications under development will improve tracking ability. Trim lift is the primary source of sensor error; its effect can be reduced by close construction tolerances, rolling, or active control. Wind tunnel measurements, flight tests, and computer processing and simulation were used to support theoretical analysis. Aerodynamic coefficients of the cruciform delta-winged sensor were close to theoretical values, and experimental stability derivatives allowed evaluation of frequency response at all altitudes. An optimal method for data processing was developed and is applied to theoretical and real data. It is found that simultaneous tracking by two radars allows separation of signal and noise spectra, essential to the determination of the optimal filter. Restoration of the wind input, which is dynamically modified by the sensor and radar, is investigated using inverse filtering and system iteration. Convergence limits of the iteration are defined. Dissert. Abstr.

N69-36095# Weapons Research Establishment, Adelaide (Australia).
VECTOR MISS-DISTANCE INSTRUMENTATION
J. Wood Feb. 1969 20 p refs
(WRE-TN-PD-97) Avail: CFSTI

Phototheodolites mounted on the wingtips of a target are a well established means of recording interception geometry. Supplementary information has been obtained from a very small phototheodolite on the missile. A new phototheodolite has been developed for use on small targets. Relative speed of missile and target is used as baseline for triangulation. Author

N69-36106# Institut Franco-Allemand de Recherches, St. Louis (France).
APPLICATION OF HOLOGRAPHY TO THE HYPERSONIC AERODYNAMICS IN THE FREE-FLIGHT FACILITY [APPLICATION DE L'HOLOGRAPHIE A L'AERODYNAMIQUE HYPERSONIQUE EN TUNNEL DE TIR]
P. Smigielski 7 Oct. 1968 16 p refs In FRENCH; GERMAN summary
(ISL-T-32/68) Avail: CFSTI

The use of holography for optical analyses on aerodynamic processes is studied. The hologram can be evaluated statistically by subsequent schlieren, shadow, and differential interferometric methods for desired accuracy. The first step consists in obtaining a hologram of a projectile flying at 2000 m/s. The various apparatus used for this purpose work with double or single exposure in diffuse or non-diffuse light. A Q switched ruby laser of weak coherence provides the light source, and the working part of the photographic emulsion is in the linear part of the amplitude transmission curve. For better synchronization, the ruby laser is triggered by the objective. This snapshot arrangement is also usable for picture projection with a gas laser as light source. Hologram analysis can be used to evaluate the projectile as well as its aerodynamic environment. Of special interest is the application of differential interferometry in polarized light. Transl. by G.G.

N69-36109# Institut Franco-Allemand de Recherches, St. Louis (France).
VISUALIZATION OF MOVABLE GASEOUS OBJECTS. CONTRIBUTION ON THE APPLICATION POSSIBILITIES OF SCHLIEREN METHODS AND HOLOGRAPHY TO HYPERSONIC PROCESSES IN FREE-FLIGHT FACILITIES [VISUALISATION DES OBJETS GASEUX MOBILES. CONTRIBUTION A L'ETUDE DE LA STRIOSCOPIE ET DE L'HOLOGRAPHIE APPLIQUEES AUX PHENOMENES HYPERSONIQUES DANS LES TUNNELS DE TIR]
P. Smigielski 3 Feb. 1969 15 p refs In FRENCH; GERMAN summary
(ISL-2/69) Avail: CFSTI

The possibilities of using schlieren photography and holography to visualize moving, gaseous objects at minimal phase distortion are evaluated for application to hypersonic wakes of flying bodies in low pressure atmospheres. Proposed are some modifications to improve the sensitivity of optical schlieren systems. Also studied is a quantitative evaluation method for schlieren photographs. Various parameters are evaluated for their effects on quality and sensitivity of double schlieren edge and double through flow systems of light gas guns. Holograms of hypervelocity projectiles are evaluated by shadow and schlieren methods as well as by differential interferometry in polarized light. Quality and brightness of the kineholographic pictures are studied. Transl. by G.G.

N69-36142# Institut Franco-Allemand de Recherches, St. Louis (France).
APPLICATION OF THE RADIOGRAPHIC FLASH TECHNIQUE IN MEASURING THE VELOCITY OF MICROMETEOROID-SIMULATING PROJECTILES [APPLICATION DE LA RADIOGRAPHIE-ECLAIR A LA MESURE DES VITESSES DE PROJECTILES SIMULANT LES MICROMETEORITES]
G. Herbette and F. Jamet 22 Aug. 1968 19 p refs In FRENCH; GERMAN summary
(ISL-T-25/68) Avail: CFSTI

A double X-ray flash tube has been developed for use in measuring the velocity of macro particles fired from an electrothermal gun to simulate micrometeoroids. Construction and functioning of the double tube are described. Computations show that the maximum relative error of the device does not exceed 8% in the velocity range of 20 km/s. Transl. by K.W.

N69-36152 Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire.
BEAM MONITORING AT ORSAY
B. Grossetete and D. B. Isabelle *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 3–19 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

The various systems for the monitoring of electron and photon beams are described which are in use on the Orsay 1.3 GeV linac. A schematic outline of the machine is included which also indicates most of the monitors in present use and the location of the absolute monitor, the Faraday cup. Mechanical construction, efficiency and the determination of it, and the intensity and energy ranges of each monitor are demonstrated. Two classes of monitors are in use: continuously operating, nonintercepting induction monitors and rf cavities which do not achieve very high absolute accuracy standards; and ionization chambers or secondary emission monitors calibrated against the Faraday cup which cause no perturbation of the main electron beam. The secondary emission quantameter used to monitor the gamma ray beam is also briefly described. M.H.E.

N69-36154 Cornell Univ., Ithaca, N.Y.
COMMENTS ON BEAM MONITORING AT CORNELL
J. W. DeWire *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 31–35 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Measurement standards and the calibration of the output of the linear accelerator in general are commented upon. The calibration schedule at Cornell is described using the quantameter as the basic standard coupled with secondary emission monitors. This is considered adequate to cope with the increased intensity of the accelerator which in turn has caused saturation and temperature effect problems. The quantameters are intercalibrated on a yearly schedule and consistent agreement to within about 1% is reported. M.H.E.

N69-36165 Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
A SINGLE FOIL MONITOR
E. Raquet *In* Daresbury Nucl. Phys. Labs. Beam Intensity Meas. 1968 p 152–158 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

The problems and merits of a single foil monitor are discussed. Its advantages included the monitoring of special portions of the beam, analysis of energy spectra in front of the collimator, and providing beam centering information. Disadvantages include all aspects of integration of the small beam with integrators, and the low time resolution caused by the large time constant on the integration circuit. A reference monitor device was designed to aid linear response on secondary emission with high sensitivity, and fast time resolution of secondary electron-multiplier tubes. Measurements for these tubes are also included. E.H.W.

N69-36168 Academy of Sciences (USSR), Leningrad. A. F. Ioffe Physical Technical Inst.
THE USE OF QUANTAMETERS OF VARIOUS TYPES FOR MEASUREMENT OF TOTAL BREMSSTRAHLUNG BEAM ENERGY
S. P. Kruglov and I. V. Lopatin *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 169–181 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

The quantameter based on the transition curve method which connects the total energy of a photon beam and the integral of a transition curve was used to measure total bremsstrahlung

energy. The ionization at various depths in the absorber is measured, plotted on a curve, and integrated graphically. Because of the quantameter's spectral construction, this integration was performed automatically. The Gauss-quantameter is also discussed. J.A.M.

N69-36170 Bonn Univ. (West Germany). Physikalisches Inst.
A QUANTAMETER FOR THE BONN 2.5 GeV ELECTRON SYNCHROTRON
H. Stein, R. Wedemeyer, and E. Weisse *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 187–193 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

The quantameter consisted of 12 copper plates forming a cylinder with a radius of 8.3 and a length of 12.3 X_0. The gas mixture used was argon and carbon dioxide. The electrodes were grounded, and aluminum was used to prevent their overheating. Radial energy loss was between .1 and .2%; this effect was investigated using a bremsstrahlung beam of 10 × 10 mm^2. In an analogous way, the longitudinal loss of energy at different primary energies was measured. The quantameter was calibrated against a Faraday cup at 1.1 and 1.8 GeV. In this range of energies, no energy dependence was seen. This quantum counter was compared also to a Wilson quantameter. J.A.M.

N69-36171 Cambridge Electron Accelerator, Mass.
CALIBRATION AND PERFORMANCE OF CEA QUANTAMETERS
G. F. Dell and M. Fotino *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 194–207 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

The high energy photon beams used for experimental purposes were monitored by gas-filled Wilson quantameters. The photon induced shower was developed and absorbed in 18 unplated, 1 cm thick, copper discs totalling 12.5 X_0 and having a usable, uniform 6.2" diameter free of mechanical supports. It was experimentally determined by measurements of the total number of ions collected for each incident electron, that this configuration ensures the linearity of response throughout the energy range. J.A.M.

N69-36172 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali.
INTERCALIBRATION OF THE FRASCATI QUANTAMETERS WITH MONITORS OF OTHER LABORATORIES
G. P. Murtas *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 208–209 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Wilson quantameters in electron synchrotron for gamma and electron beams total energy measurements were presented. The relationship between the measured charge and the total beam energy is given. Comparison was made between quantameters in the 1 GeV gamma ray beam with the aid of a thin ionization chamber. A comparison between a quantameter and a secondary emission monitor was also carried out using the extracted electron beam of the electron synchrotron. J.A.M.

N69-36173 Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
THE "GOLD" AND "HOLE" EFFECTS IN GOLD PLATED QUANTAMETERS
A. Ladage *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 210–217 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Calibration measurements on beam monitors were made. The Faraday cup was tested using a calorimeter and applying positive and negative potentials. A comparison was made between the Faraday cup and the calorimeter using the secondary emission monitor. The gold plating of the copper plates of the quantameters caused a low calibration constant; this yielded surfaces with stable secondary emission. The hole effect, a reduction in the response over the entrance surface of the secondary emission quantameter in contrast to the expectation of a higher efficiency at the center than the edges, due to the incomplete absorption of the electromagnetic cascade is discussed. Nonuniformity of the gold plating of the quantameter plates was found to cause the hole effect. J.A.M.

N69-36174 Daresbury Nuclear Physics Lab. (England).
DESIGN AND PERFORMANCE OF A PROTOTYPE SECONDARY EMISSION QUANTAMETER FOR USE AT DARESBURY
N. R. S. Tait *In its* Beam Intensity Meas. 1968 p 218–221 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

A Wilson quantameter filled with 10% nitrogen and 90% helium was used for monitoring photon beams. The secondary emission quantameter contained 17 copper shower plates; in an attempt to improve secondary emission, the copper plates were gold plated. The Monte Carlo calculations on cascade shower production in copper were used to calculate longitudinal shower leakage from the plates. J.A.M.

N69-36175 Lund Univ. (Sweden). LUSY Synchrotron Lab.
A CRYOGENIC CALORIMETER FOR USE AS AN ABSOLUTE REFERENCE QUANTAMETER IN LOW INTENSITY PHOTON BEAMS
B. Danielsson and G. von Dardel *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 222–225 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

A prototype calorimeter was designed to test the potential advantages at cryogenic temperatures, for use in small laboratories, as an absolute quantameter for low intensity photon beams. A description of the prototype is given in which the precision of determination of the power absorbed is limited by the reproducibility of the thermometer, stated to be 5 × 10^{-4} degrees K. Design improvements are proposed, if the preliminary tests are successful. F.O.S.

N69-36176 European Organization for Nuclear Research, Geneva (Switzerland).
NONDESTRUCTIVE PROTON BEAM PROFILE SCANNERS FOR THE CPS, BASED ON THE IONIZATION OF RESIDUAL GAS IN THE BEAM VACUUM CHAMBER
C. D. Johnson and L. Thorndahl *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 227–237 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

A family of devices based on the collection of electrons or positive ions liberated by photon beams from the residual gas in a beam vacuum chamber were tested for use as nondestructive proton beam profile monitors. Three methods were tried: (1) for electrostatic deflection of the ionization electrons across a slit detector using plane parallel electrodes, a separate accelerating field is used; (2) a basically similar technique in which the accelerating field is made to rotate through 90° or more at uniform angular velocity; and (3) a crossed electric and magnetic field technique in which ionization electrons are collected along the zero electric equipotential surface which is scanned through the beam. Descriptions of a rotating field scanner and a crossed field scanner used as the experimental devices are included. F.O.S.

N69-36178 Inst. of High Energy Physics, Serpukhov (USSR).
DEVICE FOR MEASUREMENT OF THE PROTON BEAM EMITTANCE
D. A. Demichovsky and E. F. Trojanov *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 244–251 (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

A device for the measurement of the emittance of the proton beam is described. The device was developed for measurements in the proton beam in the injection channel of the 70 GeV Serpukhov proton synchrotron. A movable slit aperture and a beam catcher, in the form of several plates are used. The measuring process is automized and takes about 15 working cycles of the PS injector. The emittance is produced on the screen of the memory oscilloscope. The device measures the beam emittance at different stages of a particle pulse. Author

N69-36179 National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.
IONISATION SYSTEMS USED ON NIMROD FOR NONDESTRUCTIVE BEAM PROFILE MEASUREMENT
I. S. K. Gardner and A. I. Borden *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 252–256 ref (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

The ionization systems used on Nimrod for the measurement of the radial and vertical beam profiles are described. These systems were built for Nimrod to measure the beam intensity profiles in the radial and vertical planes throughout the acceleration cycle. These measurements help to account for the beam loss at various points of the machine cycle and also provide final energy beam profiles for targeting and extracted beam information. These beam losses occur: (1) during injection, (2) during trapping, and (3) during the first 20 milliseconds of acceleration. A brief account is given of the results. Author

N69-36180 Daresbury Nuclear Physics Lab. (England).
CAVITY AND TOROID MONITORS AT DARESBURY
T. W. Aitken *In its* Beam Intensity Meas. 1968 p 257–259 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Transparent electron beam monitors of two types are studied: a third harmonic RF pick-up cavity, and a toroid pick-up monitor. Both types are described. The RF system is in use, tuned to the third harmonic of the NINA acceleration frequency, and the toroid system, although successfully tested to the first integrator output, requires improvement. F.O.S.

N69-36181 Stanford Linear Accelerator Center, Calif.
A PRECISION TOROIDAL CHARGE MONITOR FOR SLAC
R. S. Larsen and D. Horelick *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 260–279 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

A precision toroidal monitor in use by the Stanford Linear Accelerator Center is described. It is considered to meet the original design goals with excellent stability and reliability. The theory, electronic system, and performance are discussed, and results are tabulated. It is concluded that the toroid response is independent of the detailed structure of the beam. F.O.S.

N69-36182 Cambridge Electron Accelerator, Mass.
RF LOOP MONITOR FOR THE SYNCHROTRON ELECTRON BEAM
B. Anderson and S. M. Matin *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 280–288 (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

An RF loop monitor exploiting the radiofrequency bunching of the electron beam was developed at the Cambridge electron accelerator to meet the requirements of operation with ultrahigh vacuum, and of increased sensitivity. This monitor is considered to be clean, compact and quite insensitive to electrical noise produced by high power pulse circuits. Several monitors with nonlinear diode detector systems are operational, and a synchronous detector system is under construction. Data on the performance of the monitor are presented. Author

N69-36205*# Beckman Instruments, Inc., Fullerton, Calif. Advanced Technology Operations.
HEAT STERILIZABLE pH ELECTRODES Final Report
A. Kaplan Apr. 1969 53 p
(Contract NAS2-4388)
(NASA-CR-73364; FR-2495-10) Avail: CFSTI CSCL 14B

The important parameters that describe the characteristics of pH electrodes are span or sensitivity, impedance, and response time. The test requirements of this project called for repetitive sterilization of glass and reference electrodes and it was also necessary that these parameters either remain constant during the sterilization tests or change in a predictable manner. The design goals were maximum sensitivity to pH changes as determined by calibration with standard buffer solutions of pH4 and pH10; a response time of one minute or less; a maximum impedance of 1000 megohms for the glass electrode; and an impedance of 5,000 ohms for the reference electrode. The test results show that the electrodes were useful for pH measurements after each of the six heat sterilization and six decontamination cycles. The design goals, however, were not reached for each design parameter. The pH sensitivity of sterilized electrodes varied during each sterilization cycle. The average pH span varied from 5.22 to 6.04 pH units, with the extreme values showing a greater variation. Author

N69-36245# Weapons Research Establishment, Adelaide (Australia).
WRESTAR-A: WEAPONS RESEARCH ESTABLISHMENT SMALL TARGET AIRCRAFT RECORDER TYPE A
F. Spencer Feb. 1969 10 p refs
(WRE-TN-PD-98) Avail: CFSTI

A description of an experimental WRESTAR-A camera is presented. Its purpose is to provide photographic records of missile interceptions of the Rushton towed target, and provide data for interception geometry computation. Data for the operation of the camera are also presented. Though the camera was built for the Rushton target, it may be scaled to perform other operations. E.H.W.

N69-36278*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INDIVIDUAL ANGULAR MOMENTUM VECTOR DISTRIBUTION AND ROTATION LAWS FOR THREE DOUBLE-GIMBALED CONTROL MOMENT GYROS
Hans F. Kennel 22 Jan. 1968 34 p refs
(NASA-TM-X-53696) Avail: CFSTI CSCL 17G

The three double-gimbaled control moment gyros which constitute the actuators for one of the attitude control system modes of the Apollo telescope mount are analyzed. A distribution law and a rotation law for the individual angular momentum vectors of the control moment gyros are developed because the attitude control law, in controlling the magnitude and the dirction of the total angular momentum vector, uses only three of the available six degrees of freedom and without a distribution law, a highly undesirable distribution can develop where two of the three individual angular momentum vectors are parallel and the third is

antiparallel, reducing the total angular momentum available to one third of that which could be available with a desirable distribution. It is shown that the desirable distribution is such that, after equilibrium is achieved, the individual angular momentum vectors have equal components along the total, and results in equal angles between the individual vectors and equal angles between the individual vectors and the total. Author

N69-36304# Institut Franco-Allemand de Recherches, St. Louis (France).
MULTIPLE EXPOSURE OF A HOLOGRAM. IMAGE QUALITY WHEN USING RESTITUTION
H. Royer and P. Smigielski 10 Oct. 1968 18 p refs In FRENCH; GERMAN summary Presented at Symp. on Appl. of Coherent Light, Florence, Sep. 1968
(ISL-T-34/68) Avail: CFSTI

The distribution of the linear error of the emulsion for the various diffracted ray bundles is governed by the conditions of exposure. The following three cases are studied: superposition of a uniform screen, interferometry with double and multiple exposures, and cinehologrophy, i.e., rotation of the plate after each exposure. In each of these cases, the brightness of every restituted image can be calculated and the corresponding noise level can be determined. Experimental results are reported which are indicative of the limitations for the application of multiple-exposure holography. Transl. by K.W.

N69-36313# Institut Franco-Allemand de Recherches, St. Louis (France).
TEMPERATURE IN THE WAKE OF HYPERVELOCITY PROJECTILES DETERMINED FROM AlO BANDS [TEMPERATUR IM NACHLAUF VON HYPERSCHALLPROJEKTILEN, BESTIMMT AUS ALO-BANDEN]
H. Mach 3 Oct. 1967 42 p refs In GERMAN; FRENCH summary
(ISL-T-36/67) Avail: CFSTI

Spherical 8-mm-dia aluminum projectiles were accelerated to 5000 m/s in air at 200 Torr. The AlO band spectrum present in the wake was recorded by time-resolved photography, and the relative intensity progression of the spectra as a function of time was photometrically determined. Because of low spectral resolution of the spectrograph that was used, the obtained spectra were resolved only down to the band groups, i.e. to the point where bands with identical changes in the vibrational quantum number overlapped. It was possible to determine the vibrational temperature from the intensity relation of the band groups and the rotational temperature from the progression of the relative spectral intensity. For control purposes, temperature measurements were also obtained from the relative intensity of Al lines. All measured temperatures agree within error tolerances. Transl. by K.W.

N69-36321*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
THE HISTORY OF THE DEVELOPMENT OF THE PRINCIPLES FOR DETERMINING THE POSITION OF AN AIRCRAFT IN SPACE, BASED ON THE USE OF A PENDULUM
P. N. Polozhin *In its* Trans. of the Tenth Sci. Conf. of The Inst. of Hist. of Nat. Sci. and Tech. Sep. 1969 p 58-62 refs (See N69-36314 21-34)
Avail: CFSTI CSCL 14B

The principal developments in the types of pendulums used for determining the position of an aircraft in space are presented. The importance of the chronology of the patents granted in various countries for original structural designs of these pendulums is shown. Author

N69-36338# Weapons Research Establishment, Adelaide (Australia).
THE ASSESSMENT OF PHOTOGRAPHIC MATERIALS AS DETECTORS OF LOW CONTRAST IMAGES
F. A. Dixon, P. M. Ash, and D. I. Gravestock Nov. 1968 23 p refs
(WRE-TN-PD-96) Avail: CFSTI

The detection potential of a number of photographic films was measured using the concept of photographic signal to noise ratio as the performance criterion. The results obtained were compared with the observed limit of detection determined by subjective tests. The behaviour of the photographic signal to noise ratio when a fine grain high performance photographic film is processed in different developers for different periods of time was determined. It was shown that any attempt to increase the contrast by either forcing the development to achieve higher gammas, or by using fast coarse developers, only results in a loss of overall detection potential due to increased granularity. Author

N69-36347*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
NEW HIGH-DISPERSION, HIGH-RESOLUTION X-RAY SPECTROMETER: MEASUREMENTS OF THE CHROMIUM K ALPHA 1 AND 2 LINES
H. W. Schnopper and K. Kalata [1969] 10 p refs
(Contract NSR-22-009-321)
(NASA-CR-105594) Avail: CFSTI CSCL 14B

A high efficiency, high resolution, high dispersion, low cost x ray spectrometer is described. Although the instrument was developed primarily for space science applications, the spectrometer has a broad range of application for normal laboratory research problems. As an example of its performance, measurements of the $CrK\alpha_{1,2}$ spectrum are presented. The observed, uncorrected full-widths at half maximum intensity are: $K\alpha_1$ =2.09eV and $K\alpha_2$ =2.67eV. Fine structure details, hitherto unreported, were also observed. Author

N69-36377*# Aero Service Corp., Philadelphia, Pa.
LEM MISSION SIMULATOR FILM GRAPHICS Final Report
Jul. 1969 80 p
(Contract NAS9-5981)
(NASA-CR-101882) Avail: CFSTI CSCL 14E

The feasibility of artistically creating detail and of updating the Lunar Film Graphics is investigated by preparing a sample of the artistic rendering of the LEM Orbiter type detail. It is shown that in the area of high interest, such as the landing site, detail is rendered to provide orbiter type micro-detail, and photographically copied at a reduced scale with tone matched prints prepared from the negative. This technique results in savings. One print is centered onto a grid so that its micro-detail registers in the area of critical interest. To prepare an Orbiter detail enhanced scene, the original artwork would be placed on the easel and exposed onto a negative. Then, the original artwork is removed and the mosaic of the detail placed on the easel and double exposed in register to the first image. Author

N69-36399# Institut Franco-Allemand de Recherches, St. Louis (France).
MICROWAVE RADIOMETRY: SCIENTIFIC PROGRAM OF THE EXPERIMENT ABOARD THE VE 231 [RADIOMETRIE HYPERFREQUENCE: PROGRAMME SCIENTIFIQUE DE L'EXPERIENCE SUR VE 231]

M. Laug 26 Jun. 1968 22 p refs In FRENCH; GERMAN summary
(ISL-T-20/68) Avail: CFSTI

The experiment is designed to obtain information on the ionization, especially electron temperature, in the wake of a reentry vehicle. This is to be accomplished by measuring the microwave radiation in the wake with a radiometer installed in the aft of the reentry body. In this report, the theory of the measurements is analyzed in order to establish parametric data for the radiometer. In addition to the theory, the report specifically covers choice of frequency, integration constant, bandpass and sensitivity, reentry dynamics, accuracy, antenna data, and operating conditions. Transl. by K.W.

N69-36534# Defence Research Establishment Suffield, Ralston (Alberta).
A SELF-RECORDING PEAK PRESSURE INDICATOR
W. O. Palmer and J. C. Muirhead Feb. 1969 11 p refs
(Suffield-Memo-59/67) Avail: CFSTI

A self-recording peak pressure gage, which employs the distance traveled by a free jet of liquid as an indicator of air pressure, is described and its operational performance evaluated. The need for this instrument arises when it is necessary to measure the peak overpressure of a blast wave without using long cable lines or electronic recorders. Previous gages operated in the fractional psi range; the one described herein is capable of measurements in the 1 to 10 psi range. Satisfactory results were obtained for its response time as a function of pulse duration, as well as its reaction to temperature change and shock wave tests. A.C.R.

N69-36556# Joint Publications Research Service, Washington, D.C.
THREE-COMPONENT MARINE MAGNETOMETER
N. N. Karnaushenko 4 Sep. 1969 17 p refs Transl. into ENGLISH from the book "Elektromagnitnyye Yavleniya v More" Kiev, Naukova Dumka Press., 1968 p 22–36
(JPRS-48749) Avail: CFSTI

A towable marine magnetometer developed to measure the vertical and horizontal components of the geomagnetic field vector and the declination (angle between the magnetic and true meridians) is described, and problems involved in achieving high accuracy of measurement using the instrument are discussed. These include assurance of overall stability of the measuring systems, and stability of the vertical and horizontal position sensors in space. To attain precise declination measurements to 30 angular minutes, it is necessary that the total error measuring directions of the magnetic and true meridians not exceed the indicated value. Realization of these conditions for a towed gondola of limited dimensions represents a complex scientific and engineering problem. A.C.R.

N69-36587 National Weather Records Center, Asheville, N.C.
MICRO-MINI MEDIA
Gilbert E. Stegall *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 31–38 (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

Methods now in use and associated equipment for microfilm and microfiche handling both semi- and fully automatic, are described. Microfilm and microfiche storage devices are also discussed. ESRO

N69-36673# Tufts Univ., Medford, Mass. Dept. of Electrical Engineering.
EXPERIENCES WITH A 24-INCH BALLOON-BORNE TELESCOPE Final Report, 1 Jan. 1965–31 Dec. 1968
Alvin H. Howell 24 Mar. 1969 14 p
(Contract AF 19(628)-4958)
(AD-688218; AFCRL-69-0140) Avail: CFSTI CSCL 17/8

A 24-inch balloon-borne telescope that had been started under a previous contract was completed and then used in making twelve lunar-study flights. Results of these are reported here. Mention is also made of several important modifications that were developed during the flight program for improving the operation of this system. Also included are pertinent facts about a second 24-inch telescope that was designed and almost completely built during the period of the contract. Author (TAB)

N69-36727# Dover Instrument Corp., Waltham, Mass.
AIR BEARING APPLICATIONS IN INSPECTION INSTRUMENT DESIGN
William T. McDonald *In* Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 1–15 (See N69-36726 21-15)
Avail: CFSTI

This paper describes applications of linear and rotary hydrostatic air bearings to instruments for inspection gaging. Four particular instrument designs are described in detail. A roundness gage and a unique instrument for measuring height, flatness, and parallelism are described as examples of air bearing applications to standard gaging operations. Two specialized measuring systems, in which the designs depend very critically on the unique air bearing capabilities, are also described. The unique advantages of air bearings in these applications are pointed out in detail. Author

N69-36730# Kolk Mfg. Co., Inc., Buffalo, N.Y.
HOW GOOD ARE YOUR GAGES?
Gerald N. Gleiser *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 27–32 (See N69-36726 21-15)
Avail: CFSTI

Presented is a technique for evaluating measurement type gages and measurement systems by stepwise inspection, data collection, and analysis with the moving range method. Data have to be taken at random order to insure any drift or changes that could occur will be randomly. A data form, to be used by the reliability engineer, provides the tool for the functional analysis. The total measurement system error is determined by the summation of the repeatability and reproducibility of the obtained measured values. G.G.

N69-36766# Joint Publications Research Service, Washington, D.C.
SELECTIONS FROM GEODESY AND CARTOGRAPHY
23 Jul. 1969 20 p Transl. into ENGLISH from Russian journals
(JPRS-48476) Avail: CFSTI

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1. RADIOPROFILOGRAPH AND ITS APPLICATION IN AIRBORNE RADIO LEVELING A. V. Borodin et al p 1–12 (See N69-36767 21-14)

2. ELECTRONIC AUTOMATIC EQUIPMENT IN THE MILITARY FIELD V. Sinyak p 13–19 (See N69-36768 12-09)

N69-36767# Joint Publications Research Service, Washington, D.C.
RADIOPROFILOGRAPH AND ITS APPLICATION IN AIRBORNE RADIO LEVELING

A. V. Borodin et al *In its* Selections from Geodesy and Cartography 23 Jul. 1969 p 1–12 Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 12, 1968 p 38–43 (See N69-36766 21-14)
Avail: CFSTI

Radio altimeters, radioprofilographs, and liquid statoscopes were designed and tested for automatic reading of altitudes and heights in radio leveling of the earth's surface. Tests showed the radio altimeter more accurate in measuring hilly and mountainous areas. The statoscope was found to produce more errors than the other two. The advantage of the radioprofilograph is that it records all information on reading measurements, and provides an automatic reading of the altitude and heights used, without adjustment or change of instruments. It also produced the needed accuracy used in airborne photography and radio leveling. G.H.W.

N69-36789*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOLOGIC ORBITAL PHOTOGRAPHY: EXPERIENCE FROM THE GEMINI PROGRAM
Paul D. Lowman, Jr. *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 213–248 refs (See N69-36776 21-04)
Avail: CFSTI CSCL 14E

Orbital photography of the earth's surface performed by various Gemini flights demonstrated that such techniques are clearly feasible for geological purposes. Several specific areas of application were delineated: (1) Regional geologic mapping at scale numbers of 250,000 and above can be performed from orbital photographs with a reasonable amount of ground truth from supplementary low-altitude photography and field work. Tectonic problems, such as major wrench fault systems, are especially suitable to study by orbital photography, and geologic education can be freed from such problems as provincialism with the global coverage available from satellites. (2) Orbital photography should also be valuable in planning geological and geophysical fieldwork, making it possible to single out the most potentially interesting areas in advance. The results of regional geophysical surveys may be more easily interpreted when correlated with coverage possible from orbit. A.C.R.

N69-36815# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanics.
MEASUREMENT OF TEMPERATURE DUE TO SLIDING IN VACUA Technical Report, 1 Sep. 1966 – 30 Sep. 1968
J. D. Vasilakis and F. F. Ling Oct. 1968 88 p refs
(Contract AF 33(615)-3378)
(AD-688267; AFML-TR-68-310) Avail: CFSTI CSCL 14/2

An apparatus is designed and built for the measurement of temperatures due to friction near the interface of two sliding objects. The sliding specimen is electromagnetically suspended and rotated in the suspended position. The only elements in contact with the slider are the rider specimens which act not only as friction sources but also as bearings, guiding the rotating slider. Temperature probes in the slider are temperature sensitive resistors in a transmitter circuit. As their temperature changes, so does the frequency of transmission. In this way, temperatures are transmitted outside the system without introducing any additional contacts. Temperatures on the rider are measured with thermocouples. The normal force on the slider due to the rider and the total torque in the system are also measured. Temperatures are measured both in air and in vacuum. Simplified configurations were chosen for the slider and the rider. From these models the theory is developed which allows the use of measured temperatures as anchorage and the radiation constant as a parameter in calculating interface temperatures. Author (TAB)

N69-36818# Akademiya Nauk URSR, Kiev.
EQUIPMENT FOR MEASURING ELASTIC WAVE VELOCITIES ON ROCK SAMPLES
V. I. Shapoval and V. A. Korchin *In its* Phys. Properties of Crustal Substances 1967 p 27–36 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

Equipment for measuring the elastic wave velocities on rock samples at high pressures is described. Time measurement by the equipment allowed velocity measurements of elastic wave propagation in rock samples with a precision of up to 0.3 to 0.5% during a time of 15 to 20 μ sec. Author

N69-36819# Akademiya Nauk URSR, Kiev.
TRANSISTORIZED THERMOMETER FOR TEMPERATURE MEASUREMENTS IN BORE HOLES
V. V. Gordiyenko and R. I. Kutas *In its* Phys. Properties of Crustal Substances 1967 p 37–38 refs In RUSSIAN; ENGLISH summary (See N69-36816 21-13)
Avail: CFSTI

Diagrams and technical specifications for a thermometer for measuring the temperatures in bore-holes are given. A transistor is used as the temperature sensing element. Author

N69-36875*# Massachusetts Inst. of Tech., Cambridge.
PIPA (PULSED INTEGRATING PENDULOUS ACCELEROMETER)
George J. Bukow *In* AGARD Inertial Navigation: Systems and Components May 1968 p 429–458 refs (See N69-36851 21-21)
(Contract NAS9-4065)
Avail: CFSTI CSCL 14B

The PIPA (pulsed integrating pendulous accelerometer) used in the Apollo inertial measurement unit is a moderate cost, high performance single-degree-of-freedom, specific force integrating receiver, operating closed loop as a torque restrained pendulum. The instrument is one of a class of floated inertial components, consisting of a pendulous float magnetically suspended in a viscous fluid, signal generator and torque generator microsyne, and associated electronics and calibration modules. The paper examines in detail the theory, fabrication, and operation of the instrument. The float dynamics of a binary (two-stage) torquing loop are derived and the results of a digital simulation relating the design parameters to the oscillatory mode and response of the instrument are presented. The stability of the electromagnetic torquing circuit is shown to be one of the primary limitations of the present instrument design, and the factors that affect this stability are examined. Other areas discussed include: torque errors resulting from fluid impurities, floatation problems, failure modes, and power requirements. Author

N69-36876# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE ONERA ACCELEROMETER [L'ACCELEROMETRE ONERA A GRANDE SENSIBILITE]
Michel Delattre *In* AGARD Inertial Navigation: Systems and Components May 1968 p 459–474 refs In FRENCH (See N69-36851 21-21)
Avail: CFSTI

Production stages in the development of the ONERA accelerometer (measurement threshold ~ 10^{-9} m/s^2) are described. The underlying engineering theory, the machining of the beryllium sphere, construction along the lines of electrostatic theory, and all quality control operations on the mechanical and electronic parts are reported. Calibration in the laboratory and under simulated

environmental conditions were conducted and are represented in curves; performance data under actual flight conditions at altitude 200 km, and indications that an accelerometer of very high sensitivity will improve the precision of the level of atmospheric soundings are given. Circuit diagrams, engineering drawings, and photographs accompany the text. Transl. by M.H.E.

N69-36877# American Bosch Arma Corp., Santa Ana, Calif.
VIBRATING STRING ACCELEROMETER
Robert O. Bock *In* AGARD Inertial Navigation: Systems and Components May 1968 p 475–486 refs (See N69-36851 21-21)
Avail: CFSTI

Configurations and properties of vibrating string accelerometers are analyzed. The instruments use the transverse vibrations of a string clamped rigidly at the ends of a segment of certain length to obtain the displacement in the plane normal to the string length for small dynamic range measurements. Sensitivity is the smallest input signal to which the instrument will exhibit proper response. Accuracy is the precision with which a calibration can be repeated. The resolution is given by the smallest increment of acceleration which can be read out. G.G.

N69-36878# Litton Systems, Inc., Woodland Hills, Calif.
QUARTZ RESONATOR DIGITAL ACCELEROMETER
Norman R. Serra *In* AGARD Inertial Navigation: Systems and Components May 1968 p 487–516 refs Supported in part by Army and AF (See N69-36851 21-21)
Avail: CFSTI

The quartz resonator digital accelerometer is the result of an extensive program to develop an accelerometer with digital output using direct conversion from force to frequency. Crystalline quartz, as the basic transducer material, provides high mechanical stability, repeatability, and reliability and enables direct mechanical-to-electrical coupling using the piezoelectric properties of the material. The instrument, in its final configuration, consisted of a dual crystal, dual proof mass design with each proof mass suspended by a single cantilever spring. The electronics consisted of two independent crystal controlled circuits, with each crystal incorporated into the bridge of a high stability oscillator. Multiplier and frequency differencing circuits were developed for direct instrument readout. The design goal for the instrument was 0.02 percent linearity in the 0 to 20 g range. This was achieved and demonstrated in centrifuge tests. Author

N69-36985*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CALIBRATION OF PEGASUS AND EXPLORER 23 DETECTOR PANELS
Robert J. Naumann, David W. Jex, and Clyde L. Johnson Washington Sep. 1969 40 p refs
(NASA-TR-R-321) Avail: CFSTI CSCL 14B

Several series of tests were conducted to establish the ballistic limit for the various detector panels. In these tests extremely small, carefully sized beads were launched in a velocity range that included the perforation threshold. By varying the size, a ballistic limit curve was established on a mass-velocity plot. Such curves were then extrapolated to average meteor velocity to obtain the characteristic mass for each sensor. Additional tests were conducted on the Pegasus panels using the Pegasus test tool, which contains the identical electronic circuitry used by the flight models. These tests included hot and cold tests, thermal cycling after impact, and oblique impacts. Several types of anomalous events noted in the operation of the spacecraft could be simulated in this manner. Some indication of the dependence of detection threshold upon size was obtained. Author

N69-36988*# Techtran Corp., Glen Burnie, Md.
SYSTEMATIC ERRORS OF A HORIZON SENSOR DUE TO THE NONSPHERICITY OF THE PLANET [O METODICHESKIKH POGRESHNOSTYAKH USTROYSTVA VIZIROVANIYA GORIZONTA OT VLIYANIYA NESFERICHNOSTI PLANETY]
I. G. Ioffe Washington NASA Sep. 1969 10 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 7, no. 2, 1969 p 285–290
(Contract NASw-1695)
(NASA-TT-F-12574) Avail: CFSTI CSCL 14B

The systematic errors of devices for determining orientation and position of a spacecraft near a planet from observations of the planet's disk are analyzed in detail. The deterministic and probabilistic approaches to the problem of determining the systematic errors are compared. The results are extended to include a vehicle moving along an arbitrarily inclined orbit. The study shows that starting with a radial distance $\sqrt{3}$ times greater than the equatorial radius of the planet, the errors in the determination of this distance will increase as the altitude of the flight increases. At lower altitudes these errors are additionally determined by the angle of inclination of the orbit to the equatorial plane. Author

N69-37003# Army Foreign Science and Technology Center Washington, D.C.
RESULTS OF PHOTOTACHYMETER TD-2 TESTS
G. I. Borodulin Mar. 1969 11 p refs Transl. into ENGLISH from Geodez. i. Kartograf. (Moscow), no. 5, 1968 p 19–23
(AD-688189; FSTC-HT-23-714-68) Avail: CFSTI CSCL 17/8

The document deals with the operation of a phototachymeter. Its improvements include increased operational convenience and some increase in accuracy. The article includes three tables showing the results of detailed factory and production tests of the instrument. Distances of over 3,000 m were successfully measured under field conditions. Experience obtained through operation of Phototachymeter TD-2 reveals that the instrument may be used successfully for traverse surveys, for base leg measurements, and for triangulation measurements. TAB

N69-37008# Naval Ship Research and Development Center, Washington, D.C. Acoustics and Vibration Lab.
THE MEASUREMENT OF DYNAMIC PROPERTIES OF MATERIALS USING A TRANSFER IMPEDANCE TECHNIQUE
Jerome S. Parsons, Wallace Yater, and Fred Schloss Apr. 1969 39 p refs
(AD-688786; Rept-2981) Avail: CFSTI CSCL 20/11

The application of mechanical impedance techniques to the measurement of dynamic properties of materials is presented. The method is flexible in that it can be employed over a wide frequency range for a variety of materials (20 to 10,000 hz for rubberlike compounds). The method was used to determine the complex young's modulus, propagation constants, characteristic impedance, loss factor, etc., of viscoelastic materials. The specimen is suspended vertically and blocked at the upper end by means of a stiff force gage attached to a large isolated mass. A static tensile stress, which can be varied, ensures proper vertical alignment for the axial excitation applied at the free end of the sample. The motion of the free end is measured with an accelerometer. Instrumentation was developed to measure the phase angle between the two transducer signals to within 0.2 deg from 10 to 20,000 hz. A computer program was written to expedite the analysis of the data. The method and computer program can also be applied to the measurement of dynamic shear properties of rubberlike materials. Author (TAB)

N69-37018# Army Foreign Science and Technology Center, Washington, D.C.
MAGNETOELECTRIC TEMPERATURE GAUGES
Yu. Vorovskikh, A. Melnikov, and L. Shvalb May 1969 13 p Transl. into ENGLISH from Avtomob. Transp. (Moscow), v. 45, no. 1, 1967 p 43–45
(AD-688063; FSTC-HT-23-080-69) Avail: CFSTI CSCL 14/2

The disadvantages of ordinary electrothermal pulse temperature gauges necessitate the use of a more reliable instrument in vehicles using 24-volt electrical systems. A transistorized magnetoelectric temperature gauge incorporating a semiconductor thermal resistor as the sensitive element is proposed. Author (TAB)

N69-37032*# California Univ., Los Angeles.
CALIFORNIA UNIVERSITY, PART 1 Semiannual Report, 1 Jan.–30 Jun. 1969
30 Jun. 1969 30 p refs
(Grant NGR-05-007-004)
(NASA-CR-105753) Avail: CFSTI CSCL 14B

Task summaries, a list of resulting publications and reports, and abstracts of presentations resulting from the research during this period are presented. The summaries of work in charged particle research mention launching of electron spectrometers on OGO 5 and 6, launching of a 40-keV electron monitor on OV5-6, design of a high-speed electron detector for the S^3 satellite, and results of the radiation measuring instruments on OV1-2 and OV1-12. In magnetic field research, efforts were directed primarily toward the study of magnetohydrodynamic phenomena in the tenuous plasmas above the ionosphere and in interplanetary space. A magnetometer development project, experimental studies with Alouette 1 and ATS 1, and a theoretical study of the solar wind are mentioned. K.W.

N69-37049# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
AN APPLICATION OF A MODIFIED MASS SPECTROMETER TO SHOCK TUBE DIAGNOSTICS
Samuel Lederman and Edward F. Dawson May 1969 44 p refs
(Contract NONR-839(38); ARPA ORDER-529)
(AD-688943; PIBAL-69-14) Avail: CFSTI CSCL 22/3

This paper describes an experiment to determine the ionized species in the precursor region of strong shock waves produced in argon in a pressure driven shock tube. Theory shows that impurities may play a dominant role in the ionization processes. A quadrupole mass spectrometer was used in an attempt to determine the relative contributions of impurities. Thus far, however, the experiment has not yielded the desired results principally because of the effect of ultraviolet radiation from the precursor region on the ion detector in the mass spectrometer. Suggestions for correcting this difficulty are given with a discussion of the experiment. Author (TAB)

N69-37164# California Univ., San Diego. Visibility Lab.
AN UNDERWATER RADIANCE DISTRIBUTION CAMERA SYSTEM Final Report
Raymond C. Smith and Roswell W. Austin Apr. 1969 25 p refs
(Contract Nobsr-95251)
(AD-688196; SIO-REF-69-5) Avail: CFSTI CSCL 20/6

An oceanographic instrument has been designed, and constructed, to record the radiance distribution of natural radiant energy underwater. Essentially the instrument consists of two back-to-back cameras equipped with fish-eye (180 field of view) lenses packaged to be able to take photographs underwater upon command from the surface. From the films obtained, it is possible to determine the values of underwater radiance by means of photographic photometry. Author (TAB)

N69-37178# Stanford Univ., Calif. Dept. of Physics
A PERSISTENT CURRENT MAGNETOMETER WITH NOVEL APPLICATIONS
John M. Pierce *In* Va. Univ. Phys. of Superconducting Devices 1967 10 p refs (See N69-37176 21-09)
Avail: CFSTI

The current magnetometer is being used to measure magnetic susceptibility of large biomolecules in dilute solutions and the EPR spectrum of the molecules in water solutions. Because of its varied use, the circuit had to be improved. Tests showed this could be done by resonating the circuit with a capacitor. Comparisons are made with other magnetometers and the sensitivity of the circuits are calculated. E.H.W.

N69-37180# Cambridge Univ. (England). Cavendish Lab.
THE MEASUREMENT OF SMALL VOLTAGES USING A QUANTUM INTERFERENCE DEVICE
John Clarke *In* Va. Univ. Phys. of Superconducting Devices 1967 12 p refs (See N69-37176 21-09)
Avail: CFSTI

The properties of two weak-link devices are investigated. The junctions are parallel in a superconducting ring. From this condition a digital voltmeter was constructed to measure small voltages. The noise of the system affects the sensitivity. Examinations were made of temperature fluctuations, drifts in detecting systems, and critical current fluctuations to eliminate their noises. It is indicated from the tests that some noise can be eliminated through electronic designs. It is also believed that this would increase the sensitivity of the voltmeter. E.H.W.

N69-37181# California Univ., La Jolla.
A SUPERCONDUCTING GRAVIMETER
W. M. Prothero, Jr. and John M. Goodkind *In* Va. Univ. Phys. of Superconducting Devices 1967 12 p Supported by NSF (See N69-37176 21-09)
Avail: CFSTI

A gravimeter is proposed which would make the measurement of the earth's slow variations possible. The device has a drift rate of 10^{-12}g which makes it highly stable in principle. Two detection schemes were used: magnetic and electrostatic. Deviations of test data and calculations of the earth tide are within reasonable agreement, with deviations being attributed to the upper limit on the drift rate. E.H.W.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N69-36145# Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ACCEPTANCE TESTING OF LARGE PINION [INSPECAO COMPLETA E ACEITE DE SEM-FIM DE GRANDE PORTE]

L. X. Nepomuceno, H. Onusic, E. J. Cury, Y. M. Alessio, and M. F. Barbosa 31 Mar. 1969 14 p In PORTUGUESE; ENGLISH summary
(TR-6903.367) Avail: CFSTI

Inspection and testing of a large pinion prior to acceptance is reported. Descriptions are given of the ultrasonic testing with longitudinal, transversal, and surface waves, dye test application, micrography of the cemented surface, visual inspection, and acceptance criteria for the pinion. The results are presented together with photographs that indicate each of the observed irregularities. Author

N69-36327*# National Aeronautics and Space Administration, Washington, D.C.
THE SHAPE OF THE ELASTIC CURVE OF A WEIGHTLESS ROTATING SHAFT CARRYING ECCENTRICALLY LOCATED POINT MASSES OR DISKS
A. N. Ogurechnikov *In its* Invest. of Vibration and Stability of Aircraft Eng. Components Aug. 1969 p 1–19 (See N69-36326 21-02)
Avail: CFSTI CSCL 13I

The elastic curve of a shaft undergoing direct synchronous precession is considered for the case where the eccentricities and the torque transmitted to the shaft by the drive are the sources of vibration. The elastic curve is regarded as a plane, and its shape during resonance is assumed to be similar to that of the elastic curve in an unrestrained oscillation. Since the shaft vibrates in all axial planes with the same frequency, the elastic curve of the shaft undergoing precession during resonance vibrations must be a plane curve. The validity of this theory is proven for: (1) a shaft with two eccentrically located point masses; and (2) a shaft carrying an eccentrically coupled point mass and an obliquely seated ideal thin disk. G.G.

N69-36329*# National Aeronautics and Space Administration, Washington, D.C.
DYNAMIC COMPLIANCES IN A SYSTEM WITH FRICTION
V. M. Belepin *In its* Invest. of Vibration and Stability of Aircraft Eng. Components Aug. 1969 p 48–52 refs (See N69-36326 21-02)
Avail: CFSTI CSCL 13I

Analyzed is the dynamic compliance of a nonrotating beam of constant cross section with a moment of inertia. The beam is hinged at the ends and carries two weights with masses. It is assumed that: (1) internal friction forces are applied over the design cross sections; (2) there is no friction in the supporting hinges; (3) the moments due to rotation of weights are small; (4) the frictional forces induced in the beam by these moments are also neglected; and (5) the mass of the beam is neglected. The displacement equations formed include the stiffness factor as expressed in terms of action coefficients. The dynamic compliance in systems with several degrees of freedom at different types of friction turns out to be a complex quantity. G.G.

N69-36330*# National Aeronautics and Space Administration, Washington, D.C.
FORCED VIBRATIONS OF A FREE SHAFT WITH FRICTION
Ye. A. Artemov *In its* Invest. of Vibration and Stability of Aircraft Eng. Components Aug. 1969 p 53–70 refs (See N69-36326 21-02)
Avail: CFSTI CSCL 13I

This paper presents an attempt to calculate the amplitudes of forced flexural vibrations of a free, rotating shaft of any shape, subjected to an arbitrary load, and equipped with n damping mounts. It is assumed that the shaft deforms linearly and that the damping mounts are hydraulic (in such mounts the friction force is assumed proportional to the frequency of vibrations). The distributed bending moments due to inertia forces in the shaft are so small that they may be neglected. We shall solve this problem by using integral equations of forced flexural vibrations, which take into account viscous friction. Author

N69-36333*# National Aeronautics and Space Administration, Washington, D.C.
THE HYDROSTATIC BEARING AS A SOURCE OF VIBRATIONS
G. A. Ivanov *In its* Invest. of Vibration and Stability of Aircraft Eng. Components Aug. 1969 p 89–92 refs (See N69-36326 21-02)
Avail: CFSTI CSCL 13I

A stationary coordinate system isused to obtain the flow rate balence equation for a hydrostatic bearing with communicating chambers and with pressure distribution over its length. It is assumed that the flow in all the bearing elements is linear and that the flow in all the clearances between the connecting web of the bearing race and the shaft is equivalent to the fluid flow in a flat slot. Curves of the load factor as a function of the relative eccentricity show that, due to differences in the carrying capacity of the lburicating layer, a source of vibration exists in the bearing. Calculations develop that a five chamber bearing has the same load carrying capacity for any direction of the rotating load's vector. It is concluded that changing from a three- to a five-chamber bearing makes it possible to eliminate undesirable vibrations of the shaft which are due to the differences in the carrying capacity of the lubricating layer. G.G.

N69-36349*# Virginia Univ., Charlottesville. Dept. of Mechanical Engineering.
RIGID ROTOR DYNAMICS
Edgar J. Gunter, Jr. and P. De Choudhury Washington NASA Aug. 1969 173 p refs
(Grant NGR-47-005-050)
(NASA-CR-1391) Avail: CFSTI CSCL 13I

The dynamic motion of an unbalanced rigid body rotor in general linearized bearings is analyzed and is applicable to fluid film as well as rolling elements bearings for small bearing displacements. The complete nonlinear dynamical equations of motion, including motor acceleration, are derived by Lagrange's equations to include the influence of damped, flexibly mounted bearing supports. The dynamical equations of motion are linearized by assuming constant angular shaft velocity and shaft displacements which are small in comparison to the rotor characteristic length. Computer programs to analyze the rotor steady state motion due to unbalance and the stability and complete transient response are presented. As an example, these computer programs are applied to evaluate the characteristics of a NASA experimental hybrid gas bearing rotor system. Author

N69-36364# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DOUBLE OVERLAP GLUE JOINT
F. M. Lyubarets 24 Feb. 1969 12 p refs Transl. into ENGLISH from Samoletostroenie i Tekhn. Vozdushnogo Flota (USSR), no. 10, 1967 p 70–78
(AD-688145; FTD-HT-23-1083-68) Avail: CFSTI CSCL 13/8

The bond strength of a double overlap glue joint is theoretically calculated. The joint is treated as a packet of five rectangular plates comprising two glue layers sandwiched between the three metal plates, each characterized by its thickness and mechanical properties. The stress is considered as acting parallel to the plane, and the deformation is within the elastic limit. A stress function

is developed for each plate, and expressions are determined for the stress components which in turn, lead to the deformation components. The displacement components are developed from the geometric equations for the plane problem of the theory of elasticity. Author (TAB)

N69-36418# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
FLUIDIC DEVICE MANUFACTURE BY CHEMICAL ETCHING
W. Hayes *In its* Div. of Mech. Eng. and The Natl. Aeron. Estab. Quart. Bull. 31 Mar. 1969 p 1–30 refs (See N69-36414 21-18)
Avail: CFSTI

The manufacture of experimental fluidic devices by chemical etching of thin metallic laminates and subsequent vertical stacking has been experimentally demonstrated to have acceptable dimensional accuracy to implement device performance and evaluation for research purposes. The manufacturing process has both flexibility in flow channel configuration modification and acceptable fabrication turn-around time. Additionally, the inherent environmental tolerance of metals that may be used in the chemical etching process is sufficient for the vast majority of system applications (beryllium copper 1/2 as hard as a melting point of approximately 1600°F; an annealing temperature of 1425°–1475°F; and a 0.2% yield strength of 75,000 to 95,000 psi). Author

N69-36489# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON NONLINEAR OSCILLATIONS OF FRICTION SYSTEMS WITH A ONE-WAY LINK
O. A. Toropov 7 Mar. 1969 12 p refs Transl. into ENGLISH from Tr. Novocherkassk. Politekhn. Inst. (USSR), v. 153, 1966 p 155–159
(AD-688096; FTD-MT-24-438-68) Avail: CFSTI CSCL 20/11

A problem is given of oscillations of a system with dry friction and a one-way elastic link, for which the dependence between a force P and a displacement finite derivative is given by the formula P equals 1/2 (1 plus sgn finite derivative) B finite derivative, where B is a constant. The random character of dry friction is noted in practical systems. It is suggested that a random multiplier Phi (x) be introduced in the expression for the dependence of the friction force upon velocity, in order to account for the random character of dry friction; certain hypothetical qualitative considerations on the character of this multiplier distribution are expressed. TAB

N69-36533*# Owens-Illinois Glass Co., Pittsburgh, Pa. Fecker Systems Div.
INSTRUCTION MANUAL FOR AN ACCELEROMETER TEST SYSTEM, P/N 231-0000 (F(2)-223-008-022-1306)
R. Strane and W. Mc Kay [1969] 568 p
(Contract NAS4-1338)
(NASA-CR-96010; F-1306) Avail: CFSTI CSCL 13I

A test system consisting of a highly accurate platform used in testing and evaluating precision accelerometers is described, and instructions are included for its utilization. Through internal programming of an ac torque motor and air bearing, a constant angular acceleration of up to 5 rad/sec^2 to a velocity of up to 20 rad/sec can be achieved with very low disturbance. External programming of the dc torque motor and mechanical bearing can effect a maximum acceleration of 20 rad/sec^2 and fixed or variable rates up to 20 rad/sec. Time and position information is available in the form of 1.8 arc/sec pulse and reference outputs of 100 Hz, 1000 Hz, and 10 kHz, as well as an externally-gated 10kHz output. The precision-rate table system consists of four major components, one interconnecting cable used for table control, and 50 slip-ring circuits. A.C.R.

N69-36728# American Society for Quality Control, Milwaukee, Wis.
RELIABILY AND QUALITY: TEAMWORK FOR PRODUCT EFFECTIVENESS
1969 159 p refs Proc. of the 1969 Control Seminar, Sheraton Brock Hotel, Niagara Falls, Canada, 12 Apr. 1969 Sponsored in part by the Soc. of Reliability Engr. and ASQC of Buffalo
Avail: CFSTI

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1. AIR BEARING APPLICATIONS IN INSPECTION INSTRUMENT DESIGN W. T. Mc Donald (Dover Instr. Corp.) p 1–15 (See N69-36727 21-14)

2. INTERFACE OF QUALITY TO SALES AND MARKETING M. L. Kell (AMAX Specialty Metals, Inc.) p 17–19 (See N69-36728 21-15)

3. VALUE ENGINEERING IN INSPECTION G. N. Hodge (Bell Aerosystems Co., Buffalo, N.Y.) p 21–26 (See N69-36729 21-15)

4. HOW GOOD ARE YOUR GAGES? G. N. Glauser (Kolk Mfg. Co., Inc.) p 27–32 (See N69-36730 21-14)

5. OPERATIONAL HISTORY AND EXPERIENCE WITH THE BELL SK-5 AIR CUSHIONED VEHICLE (ACV) J. A. Cannon (Bell Aerosystems Co., Buffalo, N.Y. p 33 (See N69-36731 21-02)

6. SERVICE LIFE PREDICTIONS L. M. Usiak (Bell Aerosystems Co., Wheatfield, N.Y.) p 35–43 refs (See N69-36732 21-31)

7. WHEN DOES QUALITY BECOME RELIABILITY? J. D. Ekings (Gen. Dyn./Electron., Rochester, N.Y.) p 45–66 (See N69-36733 21-10)

8. AN INTEGRATED COMPUTERIZED RELIABILITY MONITORING PROGRAM FOR AIRCRAFT SYSTEMS AND COMPONENTS N. Ron, A. L. Reznick, and L. Das (Pan Am. World Airways, Inc., New York) p 67–77 ref (See N69-36734 21-02)

9. COMPUTER-AIDED RELIABILITY TECHNIQUES IN ELECTRONIC DESIGN R. A. Nowacki (Bell Aerosystems Co., Buffalo, N.Y.) p 79–105 (See N69-36735 21-10)

10 ECONOMICAL RELIABILITY PROGRAM DESIGN B. L. Bair and A. Fox (GE, Syracuse, N.Y.) p 111–129 refs (See N69-36735 21-26)

11. QUALITY CONTROL IN A LARGE AIRLINE R. J. Thatcher (Air Can., Montreal) p 127–150 (See N69-36737 21-02)

12. THE RELIABILITY OF THE QUASAR COLOR TELEVISION RECEIVER R. A. Kraft (Motorola, Inc., Chicago, Ill.) p 151–158 (See N69-36738 21-09)

13. CURRENT APPROACHES TO UNIFORM TIRE BUILDING A. L. Barbour (Columbian Carbon Co., Akron, Ohio) p 159–168 (See N69-36739 21-15)

N69-36729# AMAX Specialty Metals, Inc., Akron, New York.
INTERFACE OF QUALITY TO SALES AND MARKETING
Harold L. Kell *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 17–19 (See N69-36728 21-15)
Avail: CFSTI

The role quality assurance people should or must play in the marketing and sales efforts will vary somewhat depending on the type of product being sold, however they do have responsibilities in this area which are sometimes not emphasized. The role of sales and marketing personnel in the overall quality effort will also vary depending on the product and organizational structure, however the two do have responsibilities that they must assume. Some of the roles both should play will be discussed below as well as the background and organization of the author's company to put the remarks in perspective. Author

N69-36728# Bell Aerosystems Co., Buffalo, N.Y.
VALUE ENGINEERING IN INSPECTION
Gordon N. Hodge *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 21-26 (See N69-36726 21-15)
Avail: CFSTI

The use of value engineering offers a tool for accomplishing tasks at a lower cost without degradation of quality or reliability. The application of these techniques within the quality organization is discussed, with suggestions as to how the reader may obtain these benefits for himself. Author

N69-36739# Columbian Carbon Co., Akron, Ohio.
CURRENT APPROACHES TO UNIFORM TIRE BUILDING
Arthur L. Barbour *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 159-163 (See N69-36729 21-15)
Avail: CFSTI

The need for building tires of greater uniformity was examined in order to obtain a completely uniform method of manufacturing with final tuning and adjustment procedures included. Sheet treading and fiberglass belts evolved as most important innovations of the manufacturing process. G.G.

N69-36869*# Massachusetts Inst. of Tech., Cambridge.
GYRO BALL BEARINGS: TECHNOLOGY TODAY
Albert P. Freeman *In* AGARD Inertial Navigation: Systems and Components May 1968 p 313-356 refs (See N69-36851 21-21)
(Contracts NAS9-3079; F33615-68-C-1155; AF 04(694)-999)
Avail: CFSTI CSCL 13I

The spin-axis bearing package is a major determinant of gyro reliability and performance. Fractional microinch position stability over extended time periods, reliably achieved for tens of thousands of running hours, is required. Whether the ball bearing thus used runs successfully on an elastohydrodynamic fluid film or succumbs to early failure may be determined by whether or not today's bearing technology is applied. This specialized technology, applicable in many aspects to other bearings, has been developed over the past 20 years and continues to advance. Achievement of current state-of-the-art is the result of parallel development of the bearing parameters and of the means for their evaluation. Bearing metallurgy, geometry, groove-surface topography and chemistry, lubrication, ball-retainer, contaminstion control, dynamic behavior, testing, and processing variables have all been improved. Continued current effort in the areas of the lubrication mechanism, bearing dynamics, and groove surface promise further gains in consistency of achievement of life and performance goals. Author

N69-36870# Royal Aircraft Establishment, Farnborough (England).
CONICAL GAS BEARINGS FOR GYROSCOPE SPIN AXIS SUPPORT
D. Faddy and T. L. Ellis *In* AGARD Inertial Navigation: Systems and Components May 1968 p 357-374 refs (See N69-36851 21-21)
Copyright. Avail: CFSTI

The problems of the manufacture of three types of self-pressurized gas bearings are compared and the manufacture and inspection of an experimental conical bearing is described. A proposed design for a miniature gyroscope is included. Author

N69-37000# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
INTRODUCTION TO RELIABILITY THEORY [INLEIDING IN DE RELIABILITY THEORIE]
C. A. Hermans 4 Mar. 1969 71 p In DUTCH Presented at Space Travel Colloq., Utrecht, 4 Mar. 1969
(S-131) Avail: CFSTI

Theory, test calculation methods, and the related basic concepts from probability and statistics are thoroughly reviewed with a view toward application in design and production engineering. Reliability formulas are derived for wear effects and mean time between failure. Applications of the theory are demonstrated for reliability calculations in entire systems, subsystems, components, and failure rates of in-series and parallel components. Standby systems and redundancy are considered as well as optimized systems combining several different arrangements. Detailed reliability test calculations are given for point and interval estimates which cover expectation functions, standard deviations from mean service life, Poisson distributions, and density functions. Random and sequential sampling techniques are described for testing the reliability hypothesis. The concepts discussed in probability and statistics include chance, stochastic independence, distribution functions, transformation of variables, and discrete distribution. Transl. by K.W.

N69-37122# Battelle Memorial Inst., Columbus, Ohio. Columbus Labs.
A STUDY OF THE MECHANICS OF CLOSED-DIE FORGING. FORGING LOADS AND STRESSES IN CLOSED-DIE FORGING. PART 2 Interim Topical Report, 30 Dec. 1968-15 Mar. 1969
T. Altan, H. J. Henning, and A. M. Sabroff 30 Apr. 1969 31 p
(Contract DAAG46-68-C-0111)
(AD-688172; Rept-4) Avail: CFSTI CSCL 13/9

The slab method of analysis for predicting forging stresses and loads has been applied to longitudinal (axial) flow, i.e., to extrusion-type forging. Both plane strain and axisymmetric deformations were considered. The flow models have been further studied, and the necessary equations for general use are derived. The flash-line location has been shown to have little effect upon maximum forging load if die-cooling effects are not too large. The present study represents a fundamental method for obtaining detailed information on the mechanics of closed-die forging. Author (TAB)

N69-37138# Battelle Memorial Inst., Columbus, Ohio.
PROPERTIES OF METAL-OXIDE COMPOSITES Final Report, 1 May 1966-30 Apr. 1969
Jules J. Duga Apr. 1969 82 p refs
(Contract NONR-4925(00))
(AD-688171) Avail: CFSTI CSCL 11/4

This report constitutes a summary of the research carried out over a three-year period, directed toward the definition of problem areas and the exploration of possible composite systems for non-structural applications. Three principal avenues of approach have been followed: (1) the investigation of electrical and thermal conductivity in composites, with the aim of defining tools and analytical methods for potential application in NDT and associated diagnostic methods; (2) studies on the role of adhesion in composite systems, and the relationships among bulk, surface, and interface properties; (3) preliminary experiments on transport properties in $BaTiO_3$-Ni composites which show promise for unique materials, devices and systems. The research on this program had defined an entirely new class of materials and presents arguments on the potential utility of composites for nonstructural applications, with several specific examples of functional devices and materials, and reviews the application of transport theory to the analysis of materials parameters. In addition, it is shown how extensive studies on the relationships among bulk and surface properties can lead to methods for selecting materials systems to satisfy specific design criteria, taking into account the role of interface thermodynamics in the formation of adhesive bonds selected strengths for different applications. Author (TAB)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N69-36282*# Tulane Univ., New Orleans, La. Radiation Lab.
STUDY OF THE APPLICATION OF LASER TECHNOLOGY TO ATMOSPHERIC CONTAMINATION MEASURATION Final Technical Report, 1 May 1968 – 30 Apr. 1969
John U. Hidalgo 30 Apr. 1969 86 p refs
(Contract NAS12-864)
(NASA-CR-86221) Avail: CFSTI CSCL 20E

The application of laser technology to the measurement of impurities and pollutants in the atmosphere was studied. The emphasis is on techniques which are applicable to atmospheric probing from remote stations. Author

N69-36303# Institut Franco-Allemand de Recherches, St. Louis (France).
STUDY OF THE APPLICATION POSSIBILITIES OF A GAS LASER FOR CONTINUAL VELOCITY MEASUREMENT USING THE DOPPLER EFFECT [ETUDE DES POSSIBILITIES D'UTILISATION D'UN LASER A GAZ POUR LA MESURE CONTINUE DE VITESSE D'OBJETS EN MOUVEMENT A L'AIDE DE L'EFFET DOPPLER]
H. D. vom Stein, B. Koch, Ph. Rateau, and G. Schultze 30 Jan. 1969 30 p refs in FRENCH; GERMAN summary
(ISL-4/69) Avail: CFSTI

Active and passive differential methods and the use of the Michelson Interferometer with a frequency analyzer are considered in connection with the Doppler effect and coherent light for measuring the velocity of fast-moving objects. Laboratory tests with these methods are described, including the telemetry for measuring acceleration and deceleration, and the necessary electronics. Advantages and disadvantages of the methods are pointed out. The increases required in laser output in order to achieve a greater range of measurement are estimated. Transl. by K.W.

N69-36339*# Stanford Univ., Calif. Microwave Lab.
INVESTIGATION OF LASER DYNAMICS, MODULATION AND CONTROL BY MEANS OF INTRA-CAVITY TIME VARYING PERTURBATION Semiannual Status Report
S. E. Harris Jul. 1969 24 p refs
(Grant NGR-05-020-103)
(NASA-CR-105656; ML-177B; SASR-7) Avail: CFSTI CSCL 20E

This work is concerned primarily with the generation, control, and stabilization of optical frequency radiation and with obtaining tunable optical sources by means of nonlinear optical techniques. The areas investigated were techniques to produce long, high-power optical double pulses from Q-switched lasers, a ring-type optical parametric oscillator, and a proposed new method which should allow the output frequency of an optical parametric oscillator to be locked to the absorption line of an atomic transition. Results from the study indicate the systems are working well and they agree well with predictions. Author

N69-36390# Institut Franco-Allemand de Recherches, St. Louis (France).
ENERGY DISTRIBUTION DURING THE FOCUSING OF A LASER BEAM OF 1 J ON A STATIONARY TARGET AT LOW PRESSURE [REPARTITION DE L'ENERGIE LORS DE LA FOCALISATION D'UN FAISCEAU LASER DE 1 J SUR UNE CIBLE FIXE A BASSE PRESSION]
H. Fagot, P. Smigielski, M. Devand, F. Meyer, R. Meyer et al 4 Feb. 1969 52 p refs In FRENCH; GERMAN summary
(ISL-T-4/69) Avail: CFSTI

The beam of a Q-switched ruby laser was focused on stationary polished or dull polyethylene or Dural targets positioned in a low pressure chamber near the lense focus at a distance of 16 cm. All impacts showed the same characteristics at pressures between 0.1 and 760 Torr. An increase of the impacting energy from 0.1 to 0.6 or 0.8 enlarged the impact area but did not exceed 0.5 mm^2 for polyethylene and 1.5 mm^2 for Dural. Schlieren photographic and photomultiplier measurements on impact distributions at 0.6 J showed that shock pressure energies of 0.2 and 0.3 J increased faster than the impinging energy. Continuous deflection of the slit image pictured the development phase of the shock wave and the luminous distribution, whereas the total photograph showed a second shock wave. A tenth or a third of the laser beam was diffused by the target; the residue damaged the surface and broke off particles that were again emitted by the absorbing energy in an air shock wave. Thermal and thermodynamic properties of the ejected particles and absorbing energies depended on the material used and its energy density; only the emitted energy decreased with environmental pressure. Transl. by G.G.

N69-36397# Institut Franco-Allemand de Recherches, St. Louis (France).
PHOTOGRAPHIC STUDY OF HIGH-VELOCITY PROCESSES IN MULTIPLE REFLECTION OF LASER LIGHT [PHOTOGRAPHISCHE UNTERSUCHUNG VON HOECHSTGESCHWINDIGKEITSPROZESSEN IN MEHRFACH REFLEKTIERTEN LASERLICHT]
K. Vollrath and M. Hugenschmidt 7 Jun. 1968 23 p refs In GERMAN; FRENCH summary
(ISL-4/68) Avail: CFSTI

A cinematographic arrangement with optical separation of four images is described. The exposure time is less than 5 nsec, the pickup frequency exceeds 200 MHz. The light source is a Q-switched laser whose pulse duration is limited by a self-induced plasma. The image frequency is controlled by the differences in the duration of four separate impulses formed by optical splitting of the laser pulse. The application of the method is demonstrated with images obtained of a laser-induced discharge in xenon, by the effects of a focused laser in a plasma, and with images of the initial phase of a spark discharge. Transl. by K.W.

N69-36429# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PARAMETERS OF GIANT LASER PULSES IN INSTANTANEOUS Q-SWITCHING
D. I. Staselko et al 24 Feb. 1969 16 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 7, no. 6, 1967 p 838-844
(AD-688727; FTD-HT-23-1072-68) Avail: CFSTI CSCL 20/5

The paper derives approximate solutions of the differential equations for the giant laser pulses produced both by instantaneous and finite-time Q switching. Unlike earlier approximations, which apply only to certain particular conditions, the present solutions are more universal and can be used to calculate the energy and temporal parameters of the pulses. The results of the calculation are presented in the form of universal plots which make it possible to determine the giant-pulse parameters under arbitrary initial conditions, and also to determine the optimal conditions for the maximum output power, maximum energy, and minimum pulse duration. The obtained plots relate the reduced photon density in the cavity to the inversion density at different values of the frequency, the giant pulse parameters to the frequency, the pulse duration, pulse rise time, and peak power to the loss coefficient, and the maximum power to the mirror losses. It is only necessary

to know the parameters of the cavity and of the laser active medium. The use of the curves is illustrated by a numerical example. TAB

N69-38448# Westinghouse Research Labs., Pittsburgh, Pa.
ARGON ION LASER SOURCE FOR RAMAN SCATTERING STUDIES Final Report, Jan.–Dec. 1968
J. H. Parker, Jr. Apr. 1969 86 p refs
(Contract F33615-68-C-1287)
(AD-688268; AFML-TR-69-30) Avail: CFSTI CSCL 7/4

Raman studies were carried out using argon laser excitation on a variety of inorganic solids using a number of different laser tube designs. Raman data has been obtained on the low energy optical modes of metals. Measurements have been carried out on many different polytypes of silicon carbide. Several rare-earth oxides and rare-earth garnets were also studied. Author (TAB)

N69-38482*# National Aeronautics and Space Administration, Washington, D.C.
LASER BEAM POINTING TESTS
C. O. Alley and D. G. Currie *In its* Surveyor Program Results 1969 p 397–403 refs (See N69-36451 21-30)
Avail: SOD $4.75; CFSTI CSCL 20E

The potential value of well collimated laser beams for space communications is studied through the detection sensitivity of the Surveyor 7 vidicon camera operating in its integration mode. Argon–ion laser beams were directed backward through a telescope from five ground stations towards the Surveyor camera after lunar touchdown. Detection of on–off sequenced laser beam spots was confirmed by subsequent correlations of projected enlargements from photographic negatives reproduced from video tape recordings at the ground flight operations facility. One watt collumated laser beams appear as bright stars, while the uncollimated light from major cities is not detected. G.G.

N69-38578*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
RECENT ADVANCES IN LASER COMMUNICATIONS
Joseph L. Randall *In its* Res. Achievements Rev., Vol. 3, 1968 p 1–8 (See N69-36577 21-17)
Avail: CFSTI CSCL 20E

The research and development program at the Marshall Space Flight Center on electro-optical techniques is discussed and the associated problems are identified. It is shown that the high beam directivity of optical and infrared wavelengths allow high densities for communication, and accurate angle information making the lasers attractive for communications applications. Problems considered are: (1) acquisition, (2) atmospheric effects on an optical channel and what modulation format should be used to combat these effects, (3) low electrical efficiency of the lasers and modulators which in turn mean a high power consumption of the spacecraft, and (4) maintaining diffraction limited optics in space. F.O.S.

N69-38579*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LASER POINTING, TRACKING, AND RANGING
John M. Gould *In its* Res. Achievements Rev., Vol. 3, 1968 p 9/19 refs (See N69-36577 21-17)
Avail: CFSTI CSCL 20E

The use of a programed digital computer to control an early-launch laser pointing, tracking, and ranging system is investigated. The three elements of the system are presented separately. The target dynamics estimator and extrapolator describe the most likely target motion in the presence of noise. A polynomial fit for each short data span (nomially, 90 data points with a 1/64 second spacing for a total period of 1.4 seconds was determined to overlap these fitting polynomials. The estimator performance was simulated by processing measurements obtained from nominal tracking data and simulated by processing measurements obtained from nominal tracking data and simulated measurement noise. The results are presented. Author

N69-38742* # Northeastern Univ., Boston, Mass. Photochemistry and Spectroscopy Lab.
INVESTIGATION OF EW SYSTEMS FOR POTENTIAL LASER ACTION Quarterly Status Report, 1 Mar. 1969 –31 May 1969
29 Jul. 1969 9 p
(Grant NGR-22-011-025)
(NASA-CR-105748; QSR-2) Avail: CFSTI CSCL 20E

Iodine atom emission when HgI_2 is illuminated in its 2660 Å band was looked for at 1.315 microns using an interferometer spectrometer as the analyzing instrument. Although efforts were made to increase the sensitivity of the experimental arrangement, no emission was observed. It is also reported that the emission spectra in the 2100 Å to 1600 Å were recorded when HgI_2, $HgBr_2$, PbI_2, and $PbBr_2$ were separately subjected to a microwave discharge. A number of bands were found to be common to both the HgI_2 and $HgBr_2$ spectra, but not to the PbI_2 or $PbBr_2$ spectra. These common bands in the 1600 Å to 1800 Å region are depicted and listed. A large number of bands were observed in the spectrum of a microwave discharge through HgI_2 in the 1850 Å to 2100 Å region which do not appear when $HgBr_2$, PbI_2, or $PbBr_2$ are used. These bands are also depicted and tabulated. M.G.J.

N69-38747# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
LIMITATIONS OF STIMULATED BRILLOUIN SCATTERING AS A PASSIVE Q-SWITCH
D. H. Poole, R. S. Hall, A. J. Clarke, R. B. Duffey, and T. S. Playle Feb. 1969 8 p refs Submitted for publication
(RD/B/N1330) Avail: CFSTI

Passive Q-switching with a ruby laser was produced by focusing the output beam of the laser operating in the normal mode into a cell filled with distilled water. The observations are in general accord with the assumption that the mechanism involves Stimulated Brillouin Scattering (S.B.S.) but the threshold level is in disagreement with earlier predictions. Events in the water cell have been studied with fast cinephotography and are consistent with the hypothesis of S.B.S. The giant pulse is of long duration (0.5μs); the relationships between its power and energy and the normal output power and energy impose restrictions on the use of this technique as a passive Q-switch. Author

N69-37047# Library of Congress, Washington, D.C. Aerospace Technology Div.
FOREIGN LASER ABSTRACTS, VOLUME 2, NO. 5 Surveys of Foreign Scientific and Technical Literature
May 1969 120 p refs
(AD-688224; ATD-69-88-Vol-2-No.-5) Avail: CFSTI CSCL 20/5

The monthly publication is intended to bring together the current laser research and development papers published in the scientific and technical literature of the Soviet Bloc countries. All materials directly pertinent to the laser field are included under the following subject headings: Gas; Molecular beam; Glass; Semiconductor; Paramagnetic crystal; Liquid or organic media; Emission characteristics–generation dynamics; Spectroscopy of laser materials; Components; Nonlinear optics; Interaction of light energy with matter; Interaction of laser beam with atmosphere; and Applications. TAB

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N69-36019 California Inst. of Tech., Pasadena.
STRUCTURE AND PROPERTIES OF AN AMORPHOUS FERROMAGNETIC ALLOY
Stephen Chung-Hsiung Lin (Ph.D. Thesis) 1968 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-523

The structure and the electrical and magnetic properties of an amorphous alloy containing approximately 80 at.% iron, 13 at.% phosphorus, and 7 at.% carbon obtained by rapid quenching from the liquid state were studied. Transmission electron diffraction data confirmed the amorphous nature of this alloy. An analysis of the radial distribution function obtained from X-ray diffraction data indicated that the number of nearest neighbors is approximately seven, at a distance of 2.6A. The structure of the alloy can be related to that of silicate glasses and is based on a random arrangement of trigonal prisms of Fe_2P and Fe_3C types, in which the iron atoms have an average ligancy of seven. Electrical resistance measurements showed that the alloys are metallic. A minimum in the electrical resistivity vs. temperature curve was observed between 10°K to 50°K depending on the specimen, and the temperature at which the minimum occurs is related to the degree of local ordering. The Fe-P-C amorphous alloys are ferromagnetic. The Curie temperature measured by the induction method and by Mössbauer spectroscopy was 315°C. The field dependence of the magneto-resistance at temperatures from liquid helium to room temperature is similar to that found in crystalline iron.
Dissert. Abstr

N69-38085*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
THERMAL AND RADIATION STABILITY OF THIN-FILM CERMET RESISTIVE ELEMENTS
John L. Tarpley Aug. 1969 20 p refs Submitted for publication (NASA-TM-X-63639; X-735-69-333)dsAvail: CFSTI CSCL 11C

Recent laboratory experiments indicate that cermet thin-film resistors consisting of a mixture of 80 percent chromium and 20 percent silicon monoxide can be fabricated to a high sheet resistance of 4500 ohms per square with pronounced thermal and radiation stability. Cermet films produced had a thermal stability of <1ppm/°C from −50°C to +175°C and a radiation stability of >1% variance in absolute resistance for fluences up to 1×10^{15} e/cm² at a 1.5 Mev energy level. Cermet resistor fabrication techniques are shown to be physically compatible with silicon semiconductor integrated circuit technology. Cermet thin-film resistors offer a stable, wide-range alternative to the inherent instabilities and relatively narrow range of values of present-day silicon resistors.
Author

N69-38086# ARA, Inc., West Covina, Calif.
RESEARCH ON ENERGY ABSORBING STRUCTURES, PART 7 Annual Report, 1 Feb. 1968–1 Feb. 1969
Bernard Mazezsky, T. H. Lin, Shen-Rong Lin, and Chi-Kung Yu Mar. 1969 56 p refs
(Contract F44620-68-C-0041)
(AD-687489; ARA-101; AFORSR-69-0645TR) Avail: CFSTI CSCL 11/6

Specimens of aluminum alloys, stainless steel and beryllium copper under static compressive stresses were tested in low cycle fatigue in torsion. The data obtained indicates that compressive stress increases the low cycle fatigue life of all these specimens. This effect is similar to the effect of hydrostatic pressure which improves the fatigue behavior of metals under torsion as reported by previous investigators. Cyclic torsion tests with no axial stress were also conducted on these metals. The results of these cyclic torsion tests without axial stress are approximated by the empirical low cycle fatigue relation proposed by Coffin and Manson.
Author (TAB)

N69-38221*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
HOT-SALT-STRESS-CORROSION CRACKING AND ITS EFFECT ON TENSILE AND STRESS-RUPTURE PROPERTIES OF TI–8Al–4V TITANIUM-ALLOY SHEET
Dick M. Royster Washington Sep. 1969 38 p refs
(NASA-TN-D-5417) Avail: CFSTI CSCL 11F

Self-stressed, tensile, and stress-rupture specimens were made from 0.040-inch-thick (1.0 mm) annealed sheet. The self-stressed specimens, with stresses of 25 and 50 ksi (170 and 340 MN/m²), were sprayed with a 3.4-percent sodium chloride solution and exposed at temperatures from 500° F to 800° F (530 K to 590 K) up to 10,000 hours. Cracking was obtained after approximately 20 hours at 600° F for the 50 ksi stress, but no cracking was noted at 500° F for up to 10,000 hours at either stress. The tensile specimens were salt coated in the same manner as the self-stressed specimens and exposed up to 1600 hours at temperatures from 550° F to 850° F (590 K to 620 K) and 50 ksi stress to develop and grow hot-salt-stress-corrosion cracks. When tested at room temperature, the presence of stress-corrosion cracks resulted in a large reduction in elongation. There was also a large decrease in tensile strength for the specimens exposed at 650° F. The salt-coated stress-rupture specimens were exposed at temperatures from 600° F to 700° F (590 K to 650 K) for stresses of 50 to 100 ksi (340 to 690 MN/m²) until rupture occurred. A time-temperature parameter analysis was made of both the crack-initiation and stress-rupture data. A difference between the time for crack initiation and the time for stress rupture by a factor on the order of 300 was indicated.
Author

N69-38297# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE EFFECT OF FAST NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF SOME STAINLESS AND LOW ALLOY STEELS
R. R. Hosbons and B. L. Wotton Feb. 1969 44 p refs
(AECL-3363) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $1.00

An experiment was undertaken to find the effect of fast neutron irradiation on present and candidate pressure tube end-fitting materials. Mechanical test specimens were irradiated to an integrated neutron flux of 8×10^{19} n/cm² in pressurized water at 300°C simulating end-fitting service. The change in transition temperature for these materials was found to be ~ 70°C for AISI 403 and 431 stainless steels and 15°C for SA335 P22, a 2-1/4 CR-1 Mo low alloy steel. The 2-1/4 CR-1 Mo low alloy steel is recommended for use as the end-fitting material in future power reactors.
Author

N69-38387*# Goodyear Aerospace Corp., Akron, Ohio.
NITINOL CHARACTERIZATION STUDY
William B. Cross, Anthony H. Kariotis, and Frederick J. Stimler Washington NASA Sep. 1969 69 p refs
(Contract NAS1-7522)
(NASA-CR-1433; GER-14188) Avail: CFSTI CSCL 11F

Nickel–titanium alloys were tested for its suitability for potential applications in space. Materials from several melts were fabricated into rods, wires, and foils for the investigation. The alloy shows remarkable recovery behavior after being molded into other

shapes. Results indicate that improved processing techniques could produce even greater mechanical work from 55-Nitinol. Indications are that the substance can be used in space applications for expandable and erectable structures. E.H.W.

N69-36432# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A MACHINE FOR STUDYING THE INFLUENCE OF VARIABLES OF TEMPERATURE AND POWER CONDITIONS ON THE FATIGUE RESISTANCE OF REFRACTORY ALLOYS
T. K. Marinets et al 28 Feb. 1969 12 p refs Transl. into ENGLISH from *Tr. Leningr. Politekhn. Inst. (Moscow)*, no. 284, 1967 p 16–19
(AD-688730; FTD-MT-24-493-68) Avail: CFSTI CSCL 11/6

A rotating-beam fatigue machine was modified to study the thermal fatigue resistance of high temperature alloys used for turbine blades. Changes in the gas temperature of an operating turbine for a 60 min period are given; the test was designed to simulate the temperature and stress conditions as closely as possible. Schematic diagrams show the operating portions of the machine and the electric circuitry for regulating temperature and stress during the test. Author (TAB)

N69-36480# Franklin Inst., Philadelphia, Pa. Research Labs.
NON-EQUILIBRIUM EFFECT STRUCTURES PRODUCED BY DRASTIC QUENCHING FROM THE LIQUID STATE Final Report, 10 Jun. 1965–9 Jun. 1968
J. D. Meakin Mar. 1969 75 p refs
(Contract DA-31-124-ARO(D)-368)
(AD-688721; F-B2362; AROD-5409.2-MC) Avail: CFSTI CSCL 11/6

The development of high speed quenching by the splat cooling technique was followed by work on metastable systems. Studies were conducted along lines similar to traditional phase diagram research but using intentionally metastable specimens. The primary aim of this research was the deduction of structural information on the liquid state by examining amorphous material produced by splat cooling. This report describes and seeks to interpret the structure produced in pure metals by the splat cooling technique. Author (TAB)

N69-36486# Joint Publications Research Service, Washington, D.C.
VISCOSITY OF LIQUID BERYLLIUM
I. V. Milov et al 3 Sep. 1969 6 p refs Transl. into ENGLISH from *Izv. Akad. Nauk SSSR, Metal. (Moscow)*, no. 4, 1969 p 82–83
(JPRS-48743) Avail: CFSTI

The viscosity of liquid beryllium and its variation with temperature was determined from the results of measuring the thickness of the hydrodynamic layer (Prandtl layer) adjacent to the wall during turbulent flow of molten beryllium, while it was pumped in pipes, between the temperatures of 1568° to 1673°K. It is concluded that the results provide a basis to propose a hypothesis, that the most probable centers of crystallization in liquid beryllium are the quasi-crystalline regions having large dimensions near the crystallization temperature, which lead to the formation of the coarse grained structure in beryllium. F.O.S.

N69-36498*# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report, 15 Apr. – 15 Jul. 1969
R. W. Harrison Cleveland NASA 30 Jul. 1969 42 p refs
(Contract NAS3-6474)
(NASA-CR-72592; GESP-303; QPR-17) Avail: CFSTI CSCL 11F

The primary task of this program is to fabricate, operate for 10,000 hours and evaluate a T-111 rankine system corrosion test loop. Materials for evaluation include the containment alloy, T-111 (Ta-8W-2Hf) and the turbine candidate materials Mo-TZC and Cb-132M which are located in the turbine simulator of the two-phase potassium cicruit of the system. The loop design will be similar to the Cb-1Zr Rankine system corrosion test loop; a two-phase, forced convection, potassium corrosion test loop which was tested. Lithium is being heated by direct resistance in a primary loop. Heat rejection for condensation in the secondary potassium loop is being accomplished by radiation in a high vacuum environment to the water cooled chamber. The compatibility of the selected materials will be evaluated at conditions representative of space electric power system operating conditions. Author

N69-36554# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GRINDING AND POLISHING LARGE PLATES FOR AIRCRAFT SKINS
J. N. Verezub et al 7 Mar. 1969 14 p ref Transl. into ENGLISH from *Samoletostroyeniye i Tekhn. Vozdushnogo Flota (USSR)*, no. 8, 1966 p 168–173
(AD-688783; FTD-MT-24-437-68) Avail: CFSTI CSCL 11/6

Large (800 × 4000 × 5mm, 1000 × 6000 × 7 mm and 1200 × 100000x × 10 mm) wedge-shaped plates of D16AT and V95 aluminum alloys used for aircraft skins have to be either etched or milled to give them varying cross sections. After etching, the plates have to be polished. This article presents the results of an investigation of the hydroabrasive polishing method. A mixture of abrasive powder and water is ejected from a nozzle under pressure onto the etched plates. After etching, the plates had a 4th or 5th class surface finish. Hydroabrasive polishing brought it up to the 6th class. Higher surface finish (6th class) can be obtained by using finer abrasives and by decreasing the incline angle of the nozzle to 5-7 degrees. The efficiency of this method is very low and certain surface defects such as lines or scratches are not removed by hydroabrasive polishing. Author

N69-36577*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
RESEARCH ACHIEVEMENTS REVIEW. VOLUME 3: COMMUNICATION AND TRACKING RESEARCH AT MSFC
Washington 1968 83 p refs
(NASA-TM-X-53810; Rept-5) Avail: CFSTI CSCL 17B

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2. LASER POINTING, TRACKING, AND RANGING J. M. Gould p 9–19 ref (See N69-36579 21-16)
3. LUNAR ROCKET RESCUE BEACON L. B. Malone, Jr. p 21–41 refs (See N69-36580 21-07)
4. BUFFER FULLNESS CONTROLS FOR A DATA COMPRESSOR USING SATURN VEHICLE DATA G. R. Wallace p 43–54 refs (See N69-36581 21-08)
5. RADIATION EFFECTS TESTING OF SATURN TELEMETRY HARDWARD T. C. Lawson p 55–63 (See N69-36582 21-08)

N69-36638# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
A BIBLIOGRAPHY ON SELECT PROPERTIES OF ALUMINUM

Donald L. Grigsby and Sheldon J. Welles Apr. 1969 67 p refs
(Contract F33615-68-C-1225)
(AD-688261) Avail: CFSTI CSCL 11/6

This bibliography on pure aluminum and dilute aluminum alloys contains references on the following select properties: Macroscopic structure, energy band structure, electrical resistivity, emission properties, magnetic properties, optical properties, thermal properties, debye temperature and attenuation properties. Author (TAB)

N69-36644# Imperial Coll. of Science and Technology, London (England). Dept. of Metallurgy
THE EFFECT OF AN ADDITION OF 0.5 WT.-PER CENT SILVER ON THE AGEING CHARACTERISTICS OF CERTAIN Al-Cu-Mg ALLOYS
N. Sen and D. R. F. West Feb. 1968 5 p refs Sponsored by The Min. of Technol.
Avail: CFSTI

In Al-Cu-Mg alloys containing ≈3 wt.-% Cu and 1.5 wt.-% Mg aged to 190°C, hardening results from G.P.B. zone formation and heterogeneous nucleation of S on dislocation loops and helices. When 0.5 wt.-% Ag is present only a small amount of S forms in the early stages of ageing, and the peak hardness is largely associated with the presence of metastable *T* phase; on overageing, *T* dissolves and metrix precipitation of *S* occurs. The degree of hardening is increased by the silver addition and *T* forms at temperatures up to 400°C. The effect of silver is considered to originate from an increased solute-atom/vacancy interaction which reduces the number of dislocation loops available for *S* nucleation. The G.P.B. zone reversion temperature is raised by the addition of silver. Author

N69-36653*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATISTICAL ANALYSIS OF HIGH-TEMPERATURE CREEP-RATE DATA FOR ALLOYS OF TANTALUM, MOLYBDENUM, AND COLUMBIUM
William L. Maag and William F. Mattson Washington Sep. 1969 23 p refs
(NASA-TN-D-5424) Avail: CFSTI CSCL 11F

Empirical creep-rate equations are presented for the refractory-metal alloys T-111, T-222, TZM, TZC, D-43, and Cb-1Zr. These metals are considered potential structural materials for space power systems. The method of least squares was used to statistically analyze experimental creep data reported by other investigators. The form of the correlating equations is based on the theory that creep rate is a function of material temperature, stress, and structure. The equations cover a temperature range of 1256 to 1922 K (1800° to 3000° F) and a stress range of 3.4×10^8 to 5.5×10^8 Nm^{-2} (500 to 80,000 psi). The variability associated with each correlating equation is expressed in terms of its standard deviation. Author

N69-36671# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
ON THE DILUTE SOLUTIONS OF GOLD IN Bi-Sn ALLOYS
A. K. Jena, J. H. Smith, and M. B. Bever 12 May 1969 20 p refs
(Contract Nonr-3963(19))
(AD-688930; TR-9) Avail: CFSTI CSCL 11/6

In the investigation reported here, the relative partial gram-atomic enthalpy of gold at infinite dilution and the dependence of the partial gram-atomic enthalpy of gold on concentration and on temperature in various Bi-Sn alloys have been measured. The results can be interpreted in terms of the bond energies and the coordination number according to a modified quasichemical theory. Author (TAB)

N69-36697*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVALUATION OF META-BENZENEDISULFONIC ACID AS A STRESS-REDUCING ADDITIVE IN A WATTS NICKEL ELECTROPLATING BATH
J. A. Munford and C. E. Whitfield Washington Sep. 1969 9 p refs
(NASA-TN-D-5188) Avail: CFSTI CSCL 11F

The determination of the internal stress level and deposit hardness of nickel electrodeposited for a Watts-type bath containing controlled quantities of meta-benzenedisulfonic acid are described. The internal stress level was found to be highly sensitive to current density at low concentrations of the additive. As the additive concentration was increased, the stress level increased substantially, passed through a maximum, and then decreased at high concentrations. Deposit hardness was found to be more sensitive to current density than to stress level; no predictable relationship between stress and deposit hardness was observed. Author

N69-36723*# Lockheed Aircraft Corp., Sunnyvale, Calif.
EMISSIVITY COATINGS FOR LOW-TEMPERATURE SPACE RADIATORS
G. R. Cunnington, J. R. Grammer, and F. J. Smith Washington NASA Sep. 1969 refs
(Contract NAS3-7630)
(NASA-CR-1420) Avail: CFSTI CSCL 11C

Studies were made on the effects of simulated solar ultraviolet radiation, temperature, and vacuum on the stability of solar absorptance and total hemispherical emittance of seven potential low temperature space power system radiator coatings. A calorimetric in situ technique was used to measure broadband spectral and total absorptance and total hemispherical emittance as a function of time of exposure to an ultraviolet source (xenon lamp) at a 1-sun level. Exposures were for durations varying from 500 to 10,000 hr and a temperatures from 300°K to 533°K. The coatings investigated were titanium dioxide and zinc oxide pigments in methyl silicone binders; zinc oxide, zirconium silicate, and aluminum silicate in potassium silicate binders; and the optical solar reflector. The optical solar reflector was the most stable coating at 150°F, no change in its solar absorptance or total hemispherical emittance was observed during testing. Zinc oxide in potassium silicate showed the greatest stability for the paint type coatings; total hemispherical emittance remained constant and solar absorptance increased 0.05 during 10,000 hr of exposure at 422°K. Author

N69-36831*# TRW, Inc., Cleveland, Ohio. Equipment Labs.
MECHANICAL BEHAVIOR OF TANTALUM-BASE T-111 ALLOY AT ELEVATED TEMPERATURE
K. D. Sheffler, J. C. Sawyer, and E. A. Steigerwald Washington NASA Sep. 1969 27 p refs
(Contract NAS3-9439)
(NASA-CR-1436; ER-7305) Avail: CFSTI CSCL 11F

The tantalum-base alloy T-111 has been creep tested in an ultrahigh vacuum environment at temperatures and stresses chosen to provide approximately 1 percent creep in times up to 15,000 hours. Design data from five different heats are presented in the form of a Larson Miller plot for 1 percent creep life. Elevated temperature tension test data show a strain aging reaction in the 1400° to 2200° F range which produces unusual transient creep behavior. Values of activation energy and stress exponent suggest that steady state creep of T-111 is governed by a diffusion controlled microcreep mechanism rather than by nonconservative dislocation motion. Author

N69-36841# New Mexico Univ., Albuquerque.
A CRITERION FOR DYNAMIC LOW-CYCLE SHEAR FRACTURE Interim Technical Report
Frederick D. Ju, James T. P. Yao, and Teh T. Liu 10 Mar. 1969 105 p refs
(Grant AF-AFOSR-568-67)
(AD-688233; ME-39(69)AFOSR-074; AFOSR-69-0999TR) Avail: CFSTI CSCL 11/6

The present investigation establishes a cumulative-damage criterion for specimens subjected to reversed cyclic dynamic shear loads. Specimens of 6061-T6 aluminum alloy were tested under reversed shear loadings from 1 to 22 applications prior to fracture. The amount of shear deformation was measured at the center part of the critical section. The data was analyzed with the aid of a digital computer. Author (TAB)

N69-36868# Royal Aircraft Establishment, Farnborough (England).
MICROPLASTICITY IN METALS FOR PRECISION INSTRUMENTS
O. H. Wyatt *In* AGARD Inertial Navigation: Systems and Components May 1968 p 297–311 refs (See N69-36851 21-21)
Copyright. Avail: CFSTI

The microplasticity of metals is discussed and work on materials used in precision instruments is reviewed. Some new data are presented for beryllium. Variable drift in a precision gyroscope has been traced to ligament creep and steps to reduce the effect are described. Author

N69-36889# Naval Research Lab., Washington, D.C. Metallurgy Div.
ARPA COUPLING PROGRAM ON STRESS-CORROSION CRACKING Quarterly Report
G. Sandoz Mar. 1969 75 p refs
(ARPA Order-878)
(AD-689350; QR-9; URL-MR-1991) Avail: CFSTI CSCL 11/6

A progress report of the research investigations being carried out on the problem of stress-corrosion cracking of high strength materials is presented. Work concerning test techniques, materials characterization, physical metallurgy, surface studies, and corrosion fatigue is described. The report is divided into three main sections covering work on high strength titanium, steel, and aluminum. Author (TAB)

N69-37161# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF GAS CORROSION OF NICKEL ALLOYS AND THEIR PROTECTIVE COATINGS
K. I. Lutsenko 30 Jan. 1969 9 p refs Transl. into ENGLISH from Zashchitn. Pokrytiya na Metallach (Kiev), no. 1, 1967, p 149–152
(AD-688093; FTD-HT-23-680-68) Avail: CFSTI CSCL 11/6

The gas corrosion resistance of ZhS6-K and EP-99 alloy specimens was studied under conditions similar to those under which gas-turbine blades made of these alloys operate. The sulfur content of the diesel fuel, the velocity of the gas stream and the temperature of the combustion were varied, and in some cases salty water or sea water was injected into the gas stream. Author (TAB)

N69-37163# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROCHEMICAL METHOD FOR EVALUATING THE WETTABILITY OF STEEL IN A TWO-PHASE DYNAMIC SYSTEM OF ELECTROLYTE AND LIQUID HYDROCARBONS
V. F. Negreyev et al 27 Feb. 1969 16 p refs Transl. into ENGLISH from Russian Conf.
(AD-688092; FTD-MT-24-519-68) Avail: CFSTI CSCL 11/6

This article describes the development of a new method for evaluating wetting of a metal (St-3) in dynamic systems of two immiscible liquids as an electrolyte and liquid hydrocarbon. Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N69-36028# Vermont Univ., Burlington. Dept. Of Mechanical Engineering.
THE FRACTURE MECHANICS OF COMPOSITE MATERIALS
John O. Outwater and William O. Carnes *In* AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 17–29 refs (See N69-36026 20-32)
Avail: CFSTI

A critical analysis of the sources of fracture energy in a composite material shows it to be dependent on th energy of debonding of a fiber from the matrix material and on the energy stored in that fiber prior to fracture of the individual filament. This energy of debonding has been measured using a novel technique. A theoretical basis for the fracture energy of a composite has been developed relating it to the geometry, debonding energy and frictional force on a fiber. It shows that a more brittle composite can be expected if the fiber dimension is reduced, the bonding energy is increased, the frictional force is increased, or the fiber density in the laminate is reduced. The analysis further shows that a weak bond between the fiber and the matrix may be a vital factor in the usefulness of a laminate. Author

N69-36029# University of South Florida, Tampa.
MICROMECHANICS AND THE CONTINUUM LIMIT IN A FIBER COMPOSITE MATERIAL
Robert W. Ellis, Jr., and Wayne E. Carroll *In* AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 31–38 refs (See N69-36026 20-32)
Avail: CFSTI

The mechanical behavior of composite materials is often treated using continuum concepts and composite properties. Unfortunately there exist inherent size effects in these materials because of their discrete microstructural characteristics which cause the continuum model to fail when the geometry of a member reflects certain critical dimensions. Using a straightforward analysis, it was possible to predict the failure of continuum theory in the bending of a fiber composite beam. The continuum limit was related to the microstructure of the material. The continuum limit as a material property is discussed. Author

N69-36030# Army Natick Labs., Mass.
SOME PHYSICAL AND RHEOLOGICAL PROPERTIES OF A METHACRYLATE COPOLYMER SERIES
Anthony F. Wilde and John J. Ricca *In* AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 39–50 refs (See N69-36026 21-32)
Avail: CFSTI

A five-membered copolymer series was prepared from two chemically related monomers, methyl methacrylate and *n*-butyl

methacrylate. The compositions ranged from 100% of one component to 100% of the other component, and provided a series with wide-ranging properties. The densities, glass transition temperatures, and static moduli decreased monotonically with increasing concentration of the n-butyl methacrylate component. The static longitudinal strain-optical coefficients changed monotonically from negative values to positive values through the first four members of the series, but this trend was reversed with the 100% n-butyl methacrylate polymer. Some correlations were made between these characteristics and the copolymer compositions. Author

N69-36043# IIT Research Inst., Chicago, Ill.
STRESS CONCENTRATION FACTORS IN ANISOTROPIC MATERIALS
J. W. Dally and I. Alfirevich (Zagreb Univ., Yugoslavia) In AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 refs p 235–253 (See N69-36026 21-32)
Avail: CFSTI

This study treats the determination of stress concentration factors and stress distributions on the boundaries of geometric discontinuities in tension strips of anisotropic materials. The geometric discontinuities in tension strips included centrally located circular holes and semi-circular side notches. Two different anisotropic materials were employed in the analysis, namely, glass reinforced plastic with angle-ply and cross-ply glass orientations. A third glass reinforced plastic with fiber orientations arranged to produce a quasi-isotropic material was also examined to provide a means of assessing the accuracy of the birefringent coating method which was employed to establish the experimental data. Values of the stress concentration factor K_N for both the circular hole and semi-circular side notches indicate that K_N is higher for anisotropic materials than for isotropic materials. The increase in K_N is more pronounced with the highly anisotropic material such as angle-ply (+5, −5° glass orientation). Author

N69-36045# University of South Florida, Tampa. Structures, Materials, and Fluids Dept.
STRESS CONCENTRATIONS IN PARTICULATE FILLED COMPOSITE MATERIAL
B. E. Ross, J. E. Griffith, and L. Oline *In* AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 271–285 refs (See N69-36026 21-32)
Avail: CFSTI

This paper presents the first result of an extended program to examine the state of stress in a particulate composite. Two independent efforts are reported: an experimental program and an analytic program. The experimental program consists of determination of the state of stress in a series of arrays of elastic and rigid inclusions in an elastic matrix. Moiré and photoelasticity are used to determine stress concentrations. The effects of particle spacing (volumetric ratio) and particle modulus (modular ratio) are examined. The analytic program presents a method of extending the analysis of stress distributions for a single circular inclusion, either elastic or rigid, to inclusions of more general shape. Author

N69-36075# Hauser Research and Engineering Co., Boulder, Colo.
IMPACT TOUGHNESS OF BALLOON FILMS
Natl. Center for Atmospheric Res. Jul. 1969 25 p refs Sponsored by NSF Prepared for Natl. Center for Atmospheric Res. (NCAR-TN-42) Avail: CFSTI

A description is given of equipment, procedures, and tests from a study of impact toughness properties of balloon films over a period of one and one half years. Results which were presented in a number of isolated test reports are reviewed. The objective of the study was to learn if impact energy absorption capability of lightweight balloon films could be measured with reliability. Impact energy absorption at both ambient and cold temperatures was of concern, since balloons experience wide thermal variations during launch and ascent. In-flight photographs showed that film deployment and buffeting from wind shear occur while the film is in the tropopause region, probably at temperatures between −65° and −80°C. Special equipment was designed, calibrated, and evaluated in this study of impact toughness. Within this context, toughness was considered as a measure of the energy that the film could absorb during a defined rupture. Author

N69-36198*# Rohr Corp., Chula Vista, Calif.
FABRICATION AND TEST OF LIGHTWEIGHT HONEYCOMB SANDWICH STRUCTURES Final Report
James A. Scholl, Muriel L. Koss, and Jack E. Dawson 30 Jan. 1969 269 p refs Prepared for JPL *Its* Eng. Rept. 24-1512
(Contracts NAS7-100; JPL-951612)
(NASA-CR-105642) Avail: CFSTI CSCL 11I

Various combinations of metallic and nonmetallic materials in constructing lightweight bonded honeycomb structures are evaluated. Both the determination of mechanical and physical properties of minimum and other gage material combinations and the establishment of optimum fabrication techniques are included. Honeycomb sandwich test panels were fabricated from a potential list of 80 different reinforced plastic material combinations. These included material and configuration variations in the face sheets, honeycomb core, and core-to-face sheet adhesive. Facings of phenolic, epoxy, polyimide, and polyester resin systems were evaluated using various numbers of plies of several styles of glass fiber cloth laid up at different orientations. Face sheet splice and repair methods were also investigated. Hexagonal, flexcore, and dovetail honeycomb core with various cell sizes, densities, and thicknesses were used with a standard face sheet to determine comparative results. Core splice techniques were also evaluated. A comparison was made of resin-bonded panels and those utilizing epoxy, epoxy-phenolic, and polyimide adhesives which varied in thickness and form. Author

N69-36234*# Monsanto Research Corp., Dayton, Ohio.
DEVELOPMENT OF IMPROVED STRUCTURAL ADHESIVES Annual Summary Report, 1 Jul. 1967 – 3 Dec. 1968
D. Gerald Glasgow, Charles E. Mc Clung, Archie E. Follett, and Richard P. Quill 31 Jan. 1969 104 p refs
(Contract NAS8-20406)
(NASA-CR-102229; ASR-2) Avail: CFSTI CSCL 11A

The results of investigations directed toward development of an improved adhesive for bonding aluminum over the temperature range of −253°C to +150°C are presented. Three polymer systems, polyurethanes, poly-2-oxazolidones and epoxies, were investigated. Tensile shear strength from −269° to +150°C and T-peel strengths from −196° to +150°C either meet or exceed the target requirements. Adequate adhesive strengths were obtained using several aluminum surface treatments with and without primers. Investigations of poly-2-oxazolidones as adhesives show that only low 150°C strengths can be expected with systems capable of meeting low temperature strength goals; improved catalysts were also found for this system. Limited tests for modified epoxy resins designed to improve T-peel strengths show no promise of success. Results indicate poor prepolymer stability for the system. Author

N69-36272*# General Dynamics/Convair, San Diego, Calif.
FIXED INSULATION DEVELOPMENT PROGRAM Final Report

May 1969 271 p refs
(Contract NAS3-3248)
(NASA-CR-105599; GDC-BTD68-058) Avail: CFSTI CSCL 11B

The results of an improved Centaur fixed fuel tank insulation development program are reported. The program consisted of a material evaluation phase, a thermodynamic evaluation phase, design and fabrication of insulation for a full scale test tank, and performance tests. A cryogenic ground hold tanking test was performed to evaluate the adequacy of the alternate materials and to evaluate system performance. As a result of optical surface coat property tests, a silicone rubber impregnated fiberglass cloth was recommended for aerodynamic erosion protection. F.O.S.

N69-36414# National Research Council of Canada, Ottawa (Ontario).
DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT Quarterly Bulletin, 1 Jan. – 31 Mar. 1969
31 Mar. 1969 80 p refs
(DME/NAE-1969(1) Avail: CFSTI

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1. FLUIDIC DEVICE MANUFACTURE BY CHEMICAL ETCHING W. Hayes p 1 – 30 refs (See N69-36415 21-15)

2. CONTAMINATION BY PLATINUM IN A RESISTANCE FURNACE WOUND WITH PLATINUM - 20% RHODIUM WIRE E. P. Whelan, R. V. Dainty, and M. Grzedzielski p 31 – 40 refs (See N69-36416 21-18)

3. EVAPORATION OF SPRAYS J. K. S. Wong p 41 – 50 refs (See N69-36417 21-18)

N69-36416# National Aeronautical Establishment Ottawa (Ontario). Structures and Materials Lab.
CONTAMINATION BY PLATINUM IN A RESISTANCE FURNACE WOUND WITH PLATINUM-20 PER CENT RHODIUM WIRE
E. P. Whelan, R. V. Dainty, and Mary Grzedzielski *In its* Div. of Mech. Eng. and the Natl. Aeron. Estab. Quart. Bull. 31 Mar. 1969 p 31 – 40 refs (See N69-36414 21-18)
Avail: CFSTI

The cyclic oxidation of oxidation-resistant aluminide-coated superalloy specimens has been carried out in this laboratory at 1093°C (2000°F) using tube furnaces wound with either Kanthal (Fe - 25% Cr - 2% Co - 5% Al) wire, or Pt - 20% Rh wire. After these tests were completed, a spectrographic analysis of the coatings on specimens oxidized in the Pt-Rh furnace indicated that the coatings had become contaminated with trace amounts of platinum metal during testing. If the oxidation resistance of these coatings had been influenced by the platinum, the observed oxidation resistance would not be characteristic of the original coatings and could not be compared with results obtained from other furnaces or from other investigations. A combination of X ray diffraction and electron probe microanalysis was used to investigate the source and extent of the platinum contamination, and the probable influence of the contamination on the observed oxidation resistance of the coatings was deduced. Author

N69-36417# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
EVAPORATION OF SPRAYS
J. K. S. Wong *In its* Div. of Mech. Eng. and the Natl. Aeron. Estab. Quart. Bull. 31 Mar. 1969 p 41 – 50 refs (See N69-36414 21-18)
Avail: CFSTI

Experimental and theoretical studies directed to the evaporation of liquid sprays must deal with varying phenomena in four categories: internal engine applications, icing simulation wind-tunnels, fire fighting, and chemical industries. The general approach in treating spray evaporation theoretically was to assume that the semi-empirical relations for single droplet evaporation are valid for the individual droplets that constitute the ensemble of the spray. Next, an arbitrary drop-size distribution relation for the spary was selected. Then the evaporation rate equation for individual drops was integrated with the drop-size distribution relation to obtain the total evaporation rate of the spray. However, even the simple distribution relation reduced to an incomplete gamma function with substitutions cannot be solved unless several functions are constants and known functions of time obtained from experimental data. M.H.E.

N69-36444*# TRW Systems Group, Redondo Beach, Calif.
EVALUATION TESTING OF PROTECTIVE COATINGS ON REFRACTORY METALS Quarterly Report
L. R. Oswalt Sep. 1969 32 p
(Contract NAS7-460)
(NASA-CR-105613; TRW-69-4711-3-145; QR-8) Avail: CFSTI CSCL 11C

This report describes evaluation testing, thermal analysis, and metallurgical analysis of protective coatings on refractory metals. Briefly, the evaluation program consists of subjecting a series of coated radiation nozzles and chambers to engine firing to evaluate their protective capabilities in a propulsive environment. Each test specimen is to be test fired 10 seconds then 1000 seconds or to failure at each of the nominal combustion temperatures of 4000°F and 4500°F. Selected chamber specimens are to be test fired for extended duration to failure at the nominal combustion temperature of 4500°F. The objectives of the engine evaluation are: to determine the time and coating temperature at point of tangible coating degradation and ultimate failure, to determine failure mode or condition of coating system metallurgically at completion of the test sequence, and to correlate the life of the coatings with processing methods and thermal environment. Author

N69-36599# Naval Research Lab., Washington, D.C. Lab. for Chemical Physics.
SURFACE CHEMISTRY OF PLASTICS REINFORCED BY STRONG FIBERS Interim Report
W. A. Zisman 14 May 1969 30 p refs
(AD-688103; NRL-6911) Avail: CFSTI CSCL 11/4

A critical and up-to-date review was made on the present knowledge of the surface chemistry and related polymer science involved in the reinforcement of thermosetting and thermoplastic materials by glass or other strong fibers. Although the emphasis is basically on the behavior of glass-reinforcing fibers and particles, wherever possible the discussion and conclusions have been presented to allow their extension directly or by analogy to other strong reinforcing solids. A selected bibliography was compiled of the most significant scientific work published to date. The treatment of the subject has been as fundamental as the scope and reliability of the available data permit. In many instances, available knowledge has been interpreted using the reviewers judgment. Where significant gaps or conflicts have been noted in the literature, they have been discussed constructively. In the concluding sections numerous highly specific recommendations have been made to stimulate or guide future research and development in this complex field. Author (TAB)

N69-36682*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE RELATIONSHIP BETWEEN ELASTICITY AND STRUCTURE OF MACROMOLECULAR NETWORKS: OUTLINE OF A NEW APPROACH

Pierre Thirion et al [1968] 25 p Transl. into ENGLISH from Rev. Gen. Caoutchouc Plastiques (France), v. 45, 1968 p 859–868 Presented at Intern. Inst. Syn. Rubber Prod., Inc. Meeting, Geneva, 5-8 Jun. 1968
(Contract NAS7-100)
(NASA-CR-105609 Avail: CFSTI CSCL 11J

A new approach has been proposed remedying the inadequacies that shed serious doubt on the ability of the classic statistical theory to provide a reasonable definition of the structure of macromolecular networks, and particularly that of rubber vulcanizates. On an experimental basis, a traction test at high temperature would conveniently supply reversible contraction-elongation relations, provided the adhesion of annular cylinders to the disks is eliminated by a quick rotation of the latter. From the theoretical point of view, the replacement of the "related" hypothesis by that of a less direct connection of the links of the net works with the elastic continuum that they constitute will eliminate the anomalies that have remained unexplained. The proposed model actually reproduces the experimental traction curves much more accurately, while accounting for the apparent conformity with classical theory of the vulcanizates, both in the compressed and the swelled state, without resorting to hypothetical supra-structures. Author

N69-36762*# RAI Research Corp., Long Island City, N.Y.
AN INVESTIGATION OF THE BASIC PROPERTIES OF IRRADIATED POLYETHYLENE MEMORY MATERIALS
Preston Keusch, Donald Greer, and John Rozembersky Washington NASA Sep. 1969 122 p refs
(Contract NAS1-7335)
(NASA-CR-1384; RAI-397) Avail: CFSTI CSCL 11H

Described are the properties, work, and conclusions reached on irradiated polyethylene memory materials. The properties affecting crosslinking, the main memory factor which determines the memory in the materials were investigated using different commercial polyethylene materials. These properties include: molecular weight, molecular weight distribution, and the degree of branching. It was found that the molecular weight distribution was the main factor that influenced the crosslinking efficiency. The conditions at which crosslinking occurs- temperature, oxygen environment, and the radiation dose were investigated. Memory studies were performed on the commercial materials to see if they completely restored after being deformed. The mechanical properties of the superior memory material tested, Poly-Eth 5555 film, were also presented. Low temperature tests, tensile tests, and modulus of elasticity were determined for all of the materials. It was concluded that the material with the best crosslinking properties had the best memory characteristics. Author

N69-36772# Thompson Aircraft Tire Corp., San Francisco, Calif.
SYNTHETIC RUBBER AIRCRAFT TIRES Final Report, Feb. 1965 – May 1969
William H. Protzmann May 1969 174 p
(AF 33(657)-15342)
(AD-691280; ASD-TR-68-70) Avail: CFSTI

The purpose of this program was to select and develop new elastomers, and from them to establish a capability of producing high-speed, type VII aircraft tires, taking advantage of the potential increases in safety, reliability and economy offered by these new elastomers over natural rubber. An added advantage to be realized in using synthetic rubber manufactured domestically would be the independence, during national emergency, from reliance on natural rubber imported from Southeast Asian sources. The synthetic formulations that were developed included tire inner liner, casing, sidewall and tread compounds as major replacement as well as bead filler, bead insulation, bead flipper and bead chafer components. In all cases, the materials were easily processed in the factory during preparation of materials and manufacture of the test tires. Dynamic performance of these test tires was essentially equivalent to that of tires produced with natural rubber materials. The development work concluded that cis-1,4 polyisoprene was suitable as a direct replacement for natural rubber in each of the elastomer compounds used in the test tires. Performance tests on the aircraft tire dynamometer confirmed the suitability of these materials in this application. Author (TAB)

N69-36804*# Solar, San Diego, Calif.
SILICIDE COATINGS FOR TANTALUM AND COLUMBIUM ALLOYS Final Summary Report, 1 Apr. 1967 – 31 Dec. 1968
H. E. Shoemaker and A. R. Stetson Aug. 1969 163 p refs
(Contract NAS3-9412)
(NASA-CR-72519; RDR-1557-2) Avail: CFSTI CSCL 11C

Twenty-six variations of silicided Mo-W-Ti-V modifier alloys were investigated for their ability to protect the T222 tantalum-base alloy. From this group, selected coatings were tested for their protection of the columbium-base alloy FS-85. The 20Mo50W15Ti15V modifier alloy yielded a silicide coating that provided protection (1) in cyclic furnace oxidation for more than 800 hours at 2400°F, (2) after ballistic impact at 170 ft/sec for 10 hours at 1600° and 2400°F, (3) during 22 slow thermal cycles to 2300°F, and (4) in oxidation-erosion rig tests at Mach 0.85 and 2400°F for over 200 hours. The standard procedure for the duplex coating application throughout the program included slurry spraying of metallic elements and hydrides and vacuum sintering, which was followed with siliciding by pack cementation. To optimize the coating process, dip slurries were developed. The dip coatings provided less protection than those applied by spray techniques, but indicated the potential for development to provide equal or superior protection. Difficulties were encountered in obtaining protection of internal surfaces using the dip coating techniques. Author

N69-36840# Army Foreign Science and Technology Center, Washington, D.C.
PROJECTION OF LUBRICANTS FROM MOLDS
M. S. Radionova, L. V. Bereznikovskaya, E. I. Penfilenck, A. Baigozhin, and A. E. Latynina Apr. 1969 9 p refs Transl. into ENGLISH from Optiko-Mekh. Prom. (Leningrad), v. 35, no. 11, 1968
(AD-688067; FSTC-HT-23-217-69) Avail: CFSTI CSCL 11/8

A method of protecting lubricants from molds by introducing the antiseptic 4-caproyl resorcin (3, 5-dihydroxyhexanophenone) is described. The use of these lubricants is recommended for optical instruments intended for application in moist tropical climates. Author (TAB)

N69-36884# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
EFFECT OF SPACE ENVIRONMENT ON MATERIALS
P. C. van der Waal 4 Jul. 1968 40 p refs
(RV-22) Avail: CFSTI

The origins and the problems of outgassing are discussed. Experiments are described where adhesives for metal bonding and fiberglass reinforced plastics were exposed to a thermal vacuum environment. Some of the adhesives show a loss of strength of more than 10% after 20 days. Weight loss curves obtained from the plastics provides more information about the behavior of these materials. Author

N69-36893# Army Foreign Science and Technology Center, Washington, D.C.
ALLOY FOR BONDING METALS TO CERAMICS

V. D. Saratovkin et al 10 Mar. 1969 5 p Transl. into ENGLISH from Izobret. Prom. Obraztsy, Tovarnye Znaki (USSR), v. 45, no. 2, 1968 p 158
(AD-688288; FSTC-HT-23-962-68) Avail: CFSTI CSCL 11/1

The report discusses the application of a titanium-base alloy containing nickel and silicon for bonding metal to ceramic materials. To reduce the bonding temperature and improve the bonds, beryllium is used as a partial or full substitute for silicon. In a variant, 0.1-2.0% beryllium or beryllium with silicon are added to alloy containing 24-36% nickel. To improve the mechanical properties of bonds, up to 10% copper is added to the alloy composition. Author (TAB)

N69-37014# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
FORMATION, STABILITY AND STRUCTURE OF PALLADIUM-SILICON BASED ALLOY GLASSES Interim Technical Report
H. S. Chen and D. Turnbull Feb. 1969 42 p refs
(Contract N00014-67-A-0298-0009)
(AD-688142; TR-19) Avail: CFSTI CSCL 11/6

A series of Pd-Si based alloy glasses were formed by quenching melts to room temperature at various cooling rates. Certain ternary alloys of Pd-Au-Si, Pd-Ag-Si and Pd-Cu-Si formed glasses with thicknesses greater and 1 mm at cooling rates as low as 100C/sec. The glass-liquid transition was exhibited thermally by both binary and ternary alloys. The rheological manifestations of the glass transition was observed qualitatively for certain of the ternary alloys. The electrical resistivity of the alloys in their various states were also measured. TAB

N69-37019# Boeing Scientific Research Labs., Seattle, Wash. Polymer Sciences Lab.
POLYETHYLENE: A MULTICOMPONENT ALLOY
Paul H. Lindenmeyer Mar. 1969 29 p refs
(AD-688105; D1-82-0828) Avail: CFSTI CSCL 11/9

In exploring the analogy between crystalline polymers and metallic alloys it becomes necessary to allow for the differences in size and anisotropy of the crystallizing entity. As a consequence of the size and anisotropy of crystalline polymers their diffusion constant is several orders of magnitude smaller than metals. The anisotropy of the polymer molecule also gives rise to a tertiary or intra molecular nucleation process which does not occur in metals. The dispersion of molecular lengths which is common in high polymers makes it necessary to compare even the purist polymer with a multicomponent alloy. The combination of low diffusion constants and the tertiary nucleation process gives rise to a multitude of metastable equilibrium states as well as kinetically inhibited transitions which tend to complicate the phase diagrams. Nevertheless when all of these factors are considered it is possible to qualitatively account for much of the observed structural behavior of crystalline polyethylene by direct analogy to multicomponent metal alloys. Author (TAB)

N69-37040# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTI-CORROSION ADDITIVES AND OPERATING-PRESERVATIVE OILS BASED ON THEM
S. E. Kreyn et al 4 Feb. 1969 22 p refs Transl. into ENGLISH from the Publ. "Usesoyuznoye Soveshchaniye Po Nauke i Tekhnologii. 2d 1966. Prisadki k Maslam. Trudy", Moscow, Izd-Vo Khimiya, 1966 p 148 157
(Contract F33657-68-D-1287)
(AD-688069; FTD-HT-23-668-68) Avail: CFSTI CSCL 11/8

Experiments with different additives indicated that lubricating oil additives based on nitrated mineral oils possessed operational, storage, and anticorrosive properties. Such lubricants reduced the penetrability of water and vapors through the oil film and also the surface tension at the boundaries of oil-water and water-adsorbed oil film. Author (TAB)

N69-37048# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOAPS AS FILLERS OF LITHIUM LUBRICANTS
I. G. Fuks et al 30 Jan. 1969 11 p refs Transl. into ENGLISH from Neftepererab. i Neftekhim. (USSR), no. 9, 1967 p 20–23
(Contract F33657-68-D-1287)
(AD-688070; FTD-HT-23-732-68) Avail: CFSTI CSCL 11/8

Results are given of an investigation of the effect of lithium ricinoleate (LiRi) additives on the structure and properties of the LiSt oil C-220 and LiSt castor oil plastic systems. The results obtained lead to several new conclusions concerning the thickening effects of soaps. Author (TAB)

N69-37125# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
BASIC RESEARCH IN NONOXIDE CERAMICS Final Report
Robert L. Coble 30 May 1969 82 p refs
(Contract Nonr-1841(82))
(AD-688201; Rept-1) Avail: CFSTI CSCL 11/2

Work on non-oxide ceramics was begun to develop basic understanding of the properties of this class of materials. Preprints and reprints of published work which was supported by this contract are appended. As written, they generally do not reflect the overall intent of the program. The yield stresses and hardness values for ZnTe, HgTe, and CdTe single crystals were correlated with total bond energy and the percent ionic bonding. The high temperature creep behavior of polycrystalline SiC was found to be governed by diffusion at grain boundaries and was attributed to control by diffusion of carbon. Dislocation dynamics were studied in CaF2 as a typical ionic compound but with a different structure (fluorite) than those which have been commonly studied (rock salt). As a related part of the program, the diffusion coefficients for carbon in SiC was determined as a function of temperature in both p-type and n-type materials. In the course of attempting to prepare TiC and subsequently TiN for electrical property measurements, it was learned that chemical vapor deposition of TiN was similar in behavior to metals as well as oxide ceramics. Thus, there is no distinction noted for the non-ionic character of bonding for this process. TAB

N69-37157# Stevens Inst. of Tech., Hoboken, N.J.
BRILLOUIN SCATTERING NEAR THE GLASS TRANSITION OF POLYMETHYL METHACRYLATE
E. A. Friedman, A. J. Ritger, and R. D. Andrews May 1969 24 p refs
(Contract N00014-68-A-0131)
(AD-689372; TR-8) Avail: CFSTI CSCL 11/9

Brillouin scattering of laser light has been used to measure the frequency of hypersonic sound waves in the range of 10 to the 10th power Hz in PMMA as a function of temperature through the glass transition region. A discontinuity in the temperature coefficient of sound velocity is observed at the glass transition temperature; this is explained as a consequence of a corresponding discontinuity in the temperature coefficient of the specific volume (thermal) expansion coefficient). The ratio of the light scattered by isothermal density fluctuations to that scattered by adiabatic density fluctuations was also measured. This ratio was large and did not change appreciably near the glass transition temperature. The value of the Landau-Placzek ratio is approximately what one would expect from previously observed ultrasonic velocity dispersion data

as a function of temperature well above the glass transition temperature. Both the velocity and intensity ratio data indicate that no velocity dispersion effects are present for the hypersonic sound waves up to temperatures 35C above the glass transition temperatures. These results also indicate that the glass transition is not a classical secondorder phase transition. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N69-36002# Purdue Univ., Lafayette, Ind. Div. of Mathematical Sciences.

PSEUDO-FOKKER PLANCK EQUATIONS AND HYPERDIFFERENTIAL OPERATORS

Stanly Steinberg and Francois Treves [1969] 62 p refs

(Grant NSF GP-07346)

Avail: Issuing Activity

This work is devoted to the study of certain characteristic Cauchy problems for linear partial differential equations which are not of a classical type (like hyperbolic or parabolic). An equation, called the optical parametric amplifier equation, occurs in the work of mathematical physicists and is the source of this study. Because the Cauchy problems considered here are characteristic, and by taking advantage of the special features of the equation, the properties of appropriate spaces of entire functions and of their duals referred to as analytic functionals are exploited. In-depth treatment in spaces of analytic functionals and by the integral representation of the solutions by means of the symbol of the resolvent is demonstrated. The Oveyannikov theorem on hyperdifferential operators is directed to these problems and found to provide a foundation to their study. Author

N69-36015*# Georgia Univ., Athens.

AN APPLICATION OF THE MULTIVARIATE EXTENDED POISSON DISTRIBUTION IN 2 TIMES 2 CONTINGENCY TABLES Final Report

H. I. Patel and S. J. Trivedi 10 Sept. 1969 Huntsville, Ala. NASA Marshall Space Flight Center 13 p refs

(Contract NAS8-11175)

(NASA-CR-61297; TR-40) Avail: CFSTI CSCL 12A

In a series of 2×2 contingency tables, suppose that $n(>1)$, the total number of individuals, varies according to a Poisson distribution. In these situations, to test the independence of the two characteristics involved, the likelihood ratio test is developed which also makes use of the additional information that the distribution of n is known to be Poisson. The unconditional distribution of the cell frequencies is obtained, and the first approximates for the iteration procedure to obtain the maximum likelihood estimates of the parameters of the distribution under the hypothesis of independence of the two characteristics are given. Author

N69-36020# Michigan State Univ., East Lansing. Statistical Lab.

APPROXIMATION TO BAYES RISK IN COMPOUND DECISION PROBLEMS

Allan Oaten Aug. 1969 55 p refs

(Grant NSF GP-13484)

(SLP-16; RM-233; AO-1) Avail: Issuing Activity

Mathematical equations are given for the set version of the compound decision problems involving simultaneous considerations of statistical decision component problems with identical generic structure consisting of finite state spaces, finite action spaces, sample spaces, and non-negative loss functions. The conditional risk, unconditional risk, the modified regret, the empirical distribution of the procedures, and the Bayes envelope in the component problem are given. Simplified standard equations are given for compound decision problems involving multiplexity of measures. Considerations are presented for subsets of the half space procedures and the equivariant, uniformly Bayes procedures. Also considered is the problem when the state space is infinite. Author

N69-36035# Drexel Inst. of Tech., Philadelphia, Pa.

TWO-DIMENSIONAL DYNAMIC ELASTICITY PROBLEMS BY THE NUMERICAL METHOD OF CHARACTERISTICS

Pei Chi Chou and Robert R. Karpp *In* AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 111-126 refs (See N69-36026 21-32)

Avail: CFSTI

The method of characteristics with three independent variables is applied to two problems: a dilatational wave in cylindrical coordinates, and the Rayleigh surface wave problem. A pure initial-value problem is solved for the dilatational wave and a mixed initial-boundary-value problem for the Rayleigh wave. Numerical results indicate that the method is accurate and practical. The error decreases if the mesh size is reduced, or if the decimal digits in the calculation is increased from 5 to 15. Reduction of the mesh ratio, the time increment divided by the space increment, delays the onset of instability. Author

N69-36058 Virginia Polytechnic Inst., Blacksburg.

A NEW FIRST ORDER SOLUTION TO THE RELATIVE MOTION PROBLEM WITH APPLICATIONS TO INTERCEPT AND RENDEZVOUS

Robert Walter Werlwas (Ph.D. Thesis) 1968 138 p

Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-3044

An improved first order linearized solution, describing the relative motion between an interceptor vehicle and a target vehicle in a circular orbit, was developed by means of a transformation of the variables which occur in the differential equations of relative motion. The results of this analysis are compared with other first order solutions and will complete solutions obtained by numerically integrating the exact, non-linear differential equations of motion. It was found that this improved first order method is considerably more accurate than those previously developed, especially for large initial separation distances between the target and the interceptor. In order to fully utilize these results they were applied to both the intercept and the rendezvous problem. In addition to the basic analysis, a method was developed to determine the time at which a velocity impulse should be applied to the interceptor in order that the total velocity impulse would be a minimum for both the intercept and rendezvous situations. Dissert. Abstr.

N69-36065# Joint Publications Research Service, Washington, D.C.

ALGEBRAIC OPERATIONS ON SYSTEMS OF OBJECTS

A. M. Slinko *In its* Soviet Cybernetics 11 Jul. 1969 p 16-23 (See N69-36066 21-04)

Avail: CFSTI

A problem which frequently arises in operational studies and synthesis of cybernetic devices is described as a rather general class of operations on systems containing fixed operations met under actual conditions. The relationship between general properties of operations on elements and those of operations on systems is analyzed in three steps: (1) formulation of the problem; (2) operations on first degree systems; and (3) operations on second degree systems. A.C.R.

N69-36126# Sao Paulo Univ. (Brazil). Center of Studies in Celestial Mechanics.
RESEARCH IN CELESTIAL MECHANICS AND DIFFERENTIAL EQUATIONS
May 1968 73 p refs
(Contract N00014-67-C-0347)
(CEMC-IPM-USP-67/68-01) Avail: CFSTI CSCL 3/3

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2. DIFFERENTIAL EQUATIONS W. M. Oliva, M. de O. Cesar, and O. F. Lopes p 28-41 refs (See N69-36128 21-19)

3. CELESTIAL MECHANICS: STABILITY OF THE TRIANGULAR POINTS IN THE ELLIPTIC RESTRICTED PROBLEM OF THREE BODIES AND NEW WAYS IN THE ELLIPTIC RESTRICTED PROBLEM L. N. F. Franca and J. L. A. N. F. Junqueira p 42-69 refs (See N69-36129 21-19)

N69-36128# Sao Paulo Univ. (Brazil). Center of Studies in Celestial Mechanics.
DIFFERENTIAL EQUATIONS
Waldyr M. Oliva, Mauro de O. Cesar, and Orlando F. Lopes *In its* Res. in Celestial Mech. and Differential Equations May 1968 p 28-41 refs (See N69-36126 21-19)
Avail: CFSTI

Five studies in the theory of differential equations and their application to dynamic problems of analysis are cited. An existence and uniqueness theorem for a semi-normal system of ordinary differential equations, and a necessary and sufficient condition of involution for a system of partial differential equations are proven. Then, LaSalle's invariance principle for multidimensional dynamical systems was studied by Liapunov's functions. Functional differential equations on compact manifolds and an approximation theorem for their solution is proven by a global geometric approach. Finally, in a consideration of Lagrangian equations for determining steady motions in stability problems, a stronger hypothesis about the minimum of a function led to the reduced stability analysis of steady motions permitting general initial conditions to be considered. M.H.E.

N69-36129# Sao Paulo Univ. (Brazil). Center of Studies in Celestial Mechanics.
CELESTIAL MECHANICS: STABILITY OF THE TRIANGULAR POINTS IN THE ELLIPTIC RESTRICTED PROBLEM OF THREE BODIES AND NEW WAYS IN THE ELLIPTIC RESTRICTED PROBLEM
Luis N. F. Franca and Jose Luiz A. N. F. Junqueira *In its* Res. in Celestial Mech. and Differential Equations May 1968 p 42-69 refs (See N69-36126 21-19)
Avail: CFSTI

The problem of the stability of the triangular points in the elliptic restricted problem of three bodies are defined and reviewed in terms of their characteristic equations. Past efforts at averaging methods to establish stability of the triangular points are also reviewed. Two methods based on Liapunov's direct method of functionals were used to solve the equation of the curve belonging to the plane limiting the linear instability zone corresponding to the elliptic problem. By matrix analysis and computer calculation, the positive real part of the roots of characteristics equations was obtained. New approaches to the study of the influence of eccentricity in the elliptic restricted problem are suggested which can be tested by the application to real space exploration models. M.H.E.

N69-36202*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
ON A FUNCTION SPACE APPROACH TO A CLASS OF LINEAR STOCHASTIC OPTIMAL CONTROL SYSTEMS
J. Y. S. Luh and M. P. Lukas Dec. 1968 183 p refs Prepared for JPL
(Contracts NAS7-100; N0014-67-A-0226)
(NASA-CR-105608; TR-EE68-36) Avail: CFSTI CSCL 12A

The stochastic optimal control problem considered is characterized by a dynamic system which is linear in the state and control vectors, and which is disturbed by additive Gaussian white noise. Incomplete, noisy observations of the state vector are available, and the control is required to be a linear feedback function of the estimated state vector. The components of the state vector and control vector which are of interest are lumped together in a response vector, and the performance index to be minimized is then a function of the statistics of the response vector. It is shown that a well-known stochastic control problem, whose performance index is the expected value of a quadratic form on the state and control, is a special case of the more general problem. Author

N69-36228*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A COMPUTATIONAL ALGORITHM FOR SEQUENTIAL ESTIMATION
Richard J. Hanson and Peter Dyer [1969] 35 p refs
(Contract NAS7-100)
(NASA-CR-105610) Avail: CFSTI CSCL 12A

This paper details a highly reliable computational algorithm for sequential least squares estimation (filtering) with process noise. The various modular components of the algorithm are described in detail so that their conversion to computer code is straightforward. These components can also be used to solve any least squares problem with possibly rank deficient coefficient matrices. Author

N69-36238 Princeton Univ., N.J.
A MULTIPLE TIME SCALES APPROACH TO THE ANALYSIS OF LINEAR SYSTEMS
Rudrapatna Venkataramaiya Ramnath (Ph.D. Thesis) 1968 202 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-2554

An investigation is made of uniform approximations to the solutions of linear differential equations with variable coefficients. The ordinary differential equations are replaced by an appropriate set of partial differential equations that determine the unknown function in terms of a set of independent time scales. The time scales are determined so as to obtain uniformly valid approximations. Bounds on the errors committed are established for the second and third order equations. The use of two time scales enables approximations to the amplitude and phase of each of the modes of n^{th} order equations. The prototypes that are of interest are the linearized equations governing the motion of VTOL aircraft. These equations constitute a system of rather high order in the time derivative (third or fourth order for motion in the plane of symmetry). The approximation method obtains the aircraft variables in terms of simply calculable functions of the stability derivatives. The results of the approximation are compared with numerical integrals of the aircraft equations for the third order hovering system and the complete fourth order equations which allow for the transition from hover to forward flight. The approximation is found to be very accurate (to within 10% error) for the third order system. For the fourth order system comparable accuracy is obtained except near the transition point. Dissert. Abstr.

N69-36289# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE ROCHE COORDINATES AND THEIR USE IN CELESTIAL MECHANICS OR HYDRODYNAMICS

Zdenek Kopal. Apr. 1969. 53 p. refs
(D1-82-0845) Avail: CFSTI

The aim of the present report is to introduce a new system of curvilinear coordinates, hereafter referred to as Roche coordinates, in which spheres of constant radius are replaced by equipotential surfaces of a rotating gravitational dipole (which consists of two discrete points of finite mass, revolving around their common center of gravity); while the remaining coordinates are orthogonal to the equipotentials. It is shown that the use of such coordinates offers a new method of approach to the solution of certain problems of particle dynamics (such as, for instance, the construction of certain types of trajectories in the restricted problem of three bodies); as well as of the hydrodynamics of gas streams in close binary systems in which the equipotential surfaces of their components distorted by axial rotation and mutual tidal interaction constitute essential boundary conditions. Author

N69-36335*# National Aeronautics and Space Administration, Washington, D.C.

THE APPLICATION OF CONFORMAL MAPPING TO PROBLEMS OF THE THEORY OF ELASTICITY

V. B. Gorlov *In its* Invest. of Vibration and Stability of Aircraft Eng. Components Aug. 1969 p 105–110 refs (See N69-36326 21-02)
Avail: CFSTI CSCL 12A

An electrical analog simulation method is used for constructing conformal mapping functions of an ellipse and a region which is filled by a disk with dovetail-shaped slots. A specific potential difference is applied to cut-out parts of these regions and the coordinates of the correspondence points are used to determine the coefficients of the conformal mapping function. Conformal mapping functions obtained are then used to construct, within a given approximation, the contour of a given region and to solve stress problems by calculating the stress concentration factors in machine parts of complex shape. G.G.

N69-36358# Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.

DEVELOPMENT OF PREDICTOR MODELS

Brian L. Ramaker, Cecil L. Smith, and Paul W. Murrill. Jun. 1969. 33 p. refs
(Contract F44620-68-C-0021; Proj. THEMIS)
(AD-688797; THEMIS-LSU-T-TR-7; AFOSR-69-1416TR) Avail: CFSTI CSCL 12/1

The typical control loop is installed to adjust the process inputs in such a manner that the process remains close to its desired operating point in face of unmeasured disturbance inputs. Box and Jenkins presented a technique for developing a control strategy based on a stochastic predictor model for the disturbances and a deterministic process model from which the process inputs to give a desired output could be calculated. This report considers the model development phase of Box and Jenkins procedure, although their entire technique for control system design will be reviewed for the readers convenience. The model development simply consists of determining the parameters in the model that give the best fit of the experimental data. This requires a multidimensional search strategy, several of which are compared in this work. It is essential to be able to implement the resulting procedure on present-day process control computers. Some practical considerations of the type of input and amount of data required are also discussed. Author (TAB)

N69-36359# Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.

CONTROL OF A HIGH ORDER PLANT USING A TIME OPTIMAL SECOND ORDER SWITCHING CURVE

Charles F. Moore, Paul W. Murrill, and Cecil L. Smith. Jun. 1969. 28 p. refs
(Contract F44620-68-C-0021; Proj. THEMIS)
(AD-688804; THEMIS-LSU-T-TR-14; AFOSR-69-1423TR) Avail: CFSTI CSCL 12/1

The application of minimum time control to a large class of chemical processes provides several unique problems not normally encountered in other fields. The nature of the problems essentially rules out any straight-forward application of the minimum principle and should be at least recognized before any workable control strategy can be designed using the potential of optimal control. This report will discuss some of the practical problems involved with directly applying minimum-time control and will offer a workable design of a time-optimal controller, applicable to the class of chemical processes under consideration. Author (TAB)

N69-36360# Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.

OPTIMUM TUNING OF A SLOW SAMPLING DIGITAL CONTROL ALGORITHM

Alfredo M. Lopez, Paul W. Murrill, and Cecil L. Smith. Jun. 1969. 30 p. refs
(Contract F44620-68-C-0021; Proj. THEMIS)
(AD-688792; THEMIS-LSU-T-TR-2; AFOSR-69-1411TR) Avail: CFSTI CSCL 12/1

The selection of control algorithms for direct digital control loops is a degree more difficult than the selection of continuous analog controllers, primarily because analog hardware considerations limit the selection to proportional, proportional-integral (PI), or proportional-integral-derivative (PID) controllers. In digital systems the counterpart to the restriction is that the algorithm must be programmable, which is indeed not very restrictive. In addition to this, another parameter--the sampling time--is also introduced. This sampling time must be fast enough to insure reasonable control, but must not be so fast that all the computers time is spent calculating the control algorithms. The use of a digital computer as a time shared controller does offer new advantages to the designer; because he is no longer restricted to the conventional modes of feedback control. The purpose of this report is to explore the advantages and disadvantages of using an algorithm other than the discrete equivalent of the typical analog controller. The running of this algorithm is investigated, followed by a comparison of its performance to that of PI and PID algorithms. Author (TAB)

N69-36361# Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.

DESIGN OF DIGITAL CONTROL ALGORITHMS USING TIME DOMAIN SPECIFICATIONS

Leonard P. Neumann, Cecil L. Smith, and Paul W. Murrill. Jun. 1969. 23 p. refs
(Contract F44620-68-C-0021; Proj. THEMIS)
(AD-688793; THEMIS-LSU-T-TR-3; AFOSR-69-1412TR) Avail: CFSTI CSCL 12/1

Design techniques for control systems generally fall into two categories: (1) frequency domain techniques and (2) time domain techniques. Frequency domain techniques have never been widely used by process engineers, perhaps because frequency response data for operating plants is seldom readily available. Thus, they have turned to time domain techniques. These approaches can be divided into two categories based on chosen performance criteria: (1) use of integral criteria such as ISE, IAE, ITAE, etc., and (2) use of specification such as rise time, settling time, decay ratio, damping ratio, percent overshoot, etc. The integral criteria have the advantage that they offer a more consistent characterization of the response, whereas the latter type of specifications has the advantage of being more directly meaningful to process engineers. The objective of this report is to present a technique by which a digital

control algorithm can be designed using these directly meaningful criteria. This approach is the application of a well-known design technique in sample-data theory to the first-order-lag-plus-dead-time model commonly used by process engineers for controller tuning. This procedure will be developed by first characterizing the process with a model and then determining the applicable control algorithm. Author (TAB)

N69-36371*# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.

AN ENDPOINT SUFFICIENCY CONDITION FOR MULTIPLE STATIONARY SOLUTIONS

Richard G. Brusch and Thomas L. Vincent Aug. 1969 332 p refs

(Grant NGR-03-002-011)

(NASA-CR-105673) Avail: CFSTI CSCL 12A

The existence of multiple solutions to a general problem of Bolza in the calculus of variations is investigated. The most important type of multiple stationary solutions occurs when a complete set of necessary and sufficient conditions have not been applied. It is shown that a sufficiency test can be broken down into a path sufficiency test and an endpoint sufficiency test and that once the first necessary conditions of the calculus of variations have been applied, the path sufficiency test and the endpoint sufficiency test can be applied independently. The results of a comprehensive study of fixed mass, single thrust, orbital transfers from initial circular orbits to a wide range of final elliptic orbits are presented. Author

N69-36379# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

MASSIVE YANG-MILLS FIELDS

H. Reiff (Inst. for Theoret. Phys., Utrecht) and M. Veltman Jun. 1969 32 p refs

(LPTHE-TH-69/43) Avail: CFSTI

Two problems are studied in the paper: (1) the relation between Lagrangian and Feynman rules if the Lagrangian contains derivative couplings and/or vector meson fields and (2) the behavior of certain two closed loop diagrams in the perturbation theory of Yang–Mills fields. With respect to (1), using an extremely simple regularization procedure, the canonical formalism is shown to give directly manifestly covariant Feynman rules. With respect to (2), a certain set of Feynman rules involving ghost particles is known to be valid for diagrams of the Yang–Mills theory with no or one closed loop. It is shown however that with this same set of rules the imaginary part of the two-loop self-energy diagrams receives a non-zero contribution of the unphysical three-ghost intermediate state. Author

N69-36389# International Training Centre for Aerial Survey, Delft (Netherlands).

ESTIMATOR FUNCTIONS FOR VARIANCES, COVARIANCES, AND FOR OTHER PARAMETERS IN BALANCING PROBLEMS[SCHAETZFUNKTIONEN FUER VARIANZEN, KOVARIANZEN UND FUER ANDERE PARAMETER IN AUSGLEICHSAUFGABEN]

K. Kubik Mar. 1969 101 p refs In GERMAN; ENGLISH summary *Its* Ser. of Ser. A, No. 44

Avail: CFSTI

Constructed are estimators for the a priori variances and covariances of random variables, which are in linear relation to the actually observed quantities. The proposed method of estimation can be regarded as a generalization of the method of least squares to estimate unknown parameters; in addition to these unknowns, also some of the a priori variances and covariances of the random variables, or some other parameters, are estimated. A mathematical model is formed for a physical system that consists of a number of definitions defining variables and relations between them as well as random variables describing non-causal variations. The probability that these random variables take a value within a definite interval can be computed from their distribution function. The distribution encompasses the mean values of the random variables and the matrix of variances and covariances. Estimators for the unknown random vectors of the matrix are reduced by regarding some of the elements in the matrix as unknowns and by actually solving them. Only a few elements of the matrix should be regarded as unknowns, thereby postulating a certain structure of the matrix. Transl. by G.G.

N69-36395# California Univ., Berkeley. Operations Research Center.

ASYMPTOTIC PROPERTIES OF ISOTONIC ESTIMATORS FOR THE GENERALIZED FAILURE RATE FUNCTION. PART 2: ASYMPTOTIC DISTRIBUTIONS

Richard E. Barlow and William R. van Zwet (Leiden Univ.) Apr. 1969 34 p refs

(Contract Nonr-3656(18); Grant NSF GK-1684)

(AD-688151; ORC-69-16) Avail: CFSTI CSCL 12/2

A general class of isotonized fixed and random window estimators are proposed and studied. These include the maximum likelihood estimators (MLEs) studied by Grenander (1956), Marshall and Proschan (1965), and Prakasa Rao (1966). By appropriate choice of the window size, we improve, asymptotically, on the MLE. For wide windows the isotonic estimators are shown to have, asymptotically, normal distributions. This is not true for the maximum likelihood estimators. Author (TAB)

N69-36396*# Rice Univ., Houston, Tex. Dept. of Mechanical and Aerospace Engineering and Materials Science.

GRADIENT METHODS IN CONTROL THEORY. PART 1: ORDINARY GRADIENT METHOD

Angelo Miele 1969 34 p refs

(Grant NGR-44-006-089)

(NASA-CR-105675; AAR-60) Avail: CFSTI CSCL 12A

An analytical approach to the gradient method is presented within the framework of the Bolza problem of the calculus of variations. The first variation is minimized subject to the linearized differential constraint and an isoperimetric constraint on the control variation. Since the resulting Euler equations are linear, the differential system describing the optimum corrections is linear. The properties of this system are studied, and the solutions are related to the stepsize α. Next, the optimization of α is performed by minimizing the sum of the first variation and the second variation; an analytical expression is derived for the optimum value of α. Thus, the present method is a hybrid, in that the shape of the system of variations is obtained from first-order considerations while the scale factor for the variations is obtained from second-order considerations. Two numerical examples illustrating the convergence properties of the algorithm are supplied. Author

N69-36421# ARINC Research Corp., Annapolis, Md.

GUIDEBOOK FOR SYSTEMS ANALYSIS/COST-EFFECTIVENESS

Fort Monmouth, N.J. ECOM Mar. 1969 451 p refs

(Contract DAAB07-68-C-0056)

(AD-688154; Publ-800-01-01-957) Avail: CFSTI CSCL 5/1

The purpose of the guidebook is to provide Army personnel with a text and reference material in Systems Analysis and Cost-Effectiveness. It is intended for those technical, scientific, management, and administrative personnel who are responsible for preparing information, making decisions or reviewing decisions

made by others regarding life-cycle cost, system effectiveness (availability, dependability, capability), or technical feasibility of a system or equipment at any phase in its life cycle. It is immediately useful to personnel who are familiar with a system or equipment under study but are not familiar with the methodology and techniques of Systems Analysis and Cost-Effectiveness.
Author (TAB)

N69-38428# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLUTION OF BOUNDARY PROBLEMS FOR THE LAPLACE EQUATION BY THE METHOD OF CONFIRMING GRIDS
V. T. Ivanov 30 Jan. 1969 11 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 7, no. 4, 1967 p 895-899
(AD-688726; FTD-HT-23-719-68) Avail: CFSTI CSCL 12/1

The solution of linear and nonlinear boundary-value problems for a two-dimensional Laplace equation with a curvilinear boundary is considered, using the theory of conformal mapping and the method of lines. The determination of the unknown arbitrary constants is reduced to the solution of a system of linear equations. The solution by the use of the obtained family of straight lines in the plane corresponds to the solution using the one-parameter family of curves. It is pointed out that such boundary value problems are encountered in physicochemical hydrodynamics. As an illustration of the method presented, the calculation of the current distribution in an electrolytic cell having the form of the annular sector and with isolated walls is presented. TAB

N69-38481# California Univ., Riverside. Dept. of Mathematics.
A GRADUATE COURSE IN PROBABILITY
Howard G. Tucker Feb. 1969 287 p refs
(Grant AF-AFOSR-851-65)
(AD-688756; AFOSR-69-1441TR) Avail: CFSTI CSCL 12/1

The book is based on a course in probability that was given to graduate students in the Department of Mathematics at UC, Riverside. Its purpose is to define one possible course in probability theory that might be given at a graduate level. The prerequisite for this text is a knowledge of real analysis or measure theory. Also the book does not contain a review of measure theory, but theorems from measure theory are used and usually fully stated. Students are expected to be familiar with the Lebesque integral over abstract spaces and its properties, in particular, the Lebesque dominated convergence theorem, Fubinis theorem, the Radon-Nikodyn theorem, etc. No previous knowledge of probability is needed. This book otherwise is self-contained and consists of exactly enough material for a one-years course in probability. The primary aim in this book is to present some of the basic theorems of analytic probability theory in a cohesive manner. Author (TAB)

N69-38487*# National Aeronautics and Space Administration, Washington, D.C.
ON A PRINCIPLE OF OPTIMIZATION OF CALCULATIONS BY THE MONTE CARLO METHOD
G. A. Mikhaylov Aug. 1969 12 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 8, no. 5, 1968 p 1085-1093
(NASA-TT-F-12364) Avail: CFSTI CSCL 12A

The solution of many problems by the Monte Carlo method reduces to simulation of homogeneous Markov chains the trajectories of which fall with unit probability into an absorbing state. As a rule, the final result is a statistical estimate of some functional of the solution of a corresponding integral equation. Various questions associated with the proof of unbiasedness and the improvements of estimates of this kind are considered. The present article is devoted to the study of one important principle in the construction of optimal algorithms of the Monte Carlo method for solving problems of the type indicated.
Author

N69-38488# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
A GENERALIZED ENGINEERING DESIGN PROCEDURE
Thomas G. Lang (Ph.D. Thesis) Pasadena, Calif. Naval Undersea Warfare Center Apr. 1969 309 p refs
(Grant Nonr(G)-00043-65)
(AD-688787; NUWC-TP-137) Avail: CFSTI CSCL 14/2

An engineering design theory is developed, which permits an entire design field to be analyzed within the framework of existing knowledge. This theory is the basis of a generalized design procedure to aid in establishing direct relationships between engineering design problems and their solutions. The procedure is basically nondimensional, so that a wide variety of design problems and their solutions can be collapsed into fundamental types. The design theory provides understanding of the nature of (and the relationships between) scaling laws, design parameters, optimization parameters, classification parameters, and research variables. Application of the generalized procedure to a design field helps to organize knowledge of that field and shows where research or invention is needed. Means of systematically simplifying and solving complex design problems are included, and relationships are established between families of design form and sets of design problems. Also included is a modification of the design theory useful in setting 9up and solving experimental research problems.
Author (TAB)

N69-38497*# Techtran Corp., Glen Burnie, Md.
CERTAIN COMPUTATIONS CONCERNING A SPECIAL CASE OF THE THREE BODY PROBLEM
Carl Burrau [1969] 8 p refs Transl. into ENGLISH from Astron. Ges., Vierteljahrfsschrift (Germany), v. 41, 1906 p 261-266 /its No. 38
(Contract NAS5-14826)
(NASA-CR-105630) Avail: CFSTI CSCL 12A

An investigation of the three body problem is presented. Computations are presented for a special case involving two volumes of equal weight with a circular motion and a third volume which is infinitely small. The investigation involves the transfer of any class of periodic solvents to an associated solvent until the mass point is approached and the class finishes the ejection path. The series expansion of all ejection paths are investigated using the Darwinian unit designator for problem similarities. A formula of a Fourier series expansion is presented to further evaluate the periodic solvent.
J.M.C.

N69-38512# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON THE APPROXIMATION OF FUNCTIONS BY FOURIER-JACOBI SUMS
S. Z. Rafalson 24 Apr. 1969 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mat. (Moscow), no. 4, 1968 p 54-62
(Contract Now-62-0604)
(AD-688283; APL-CL8-3-T-573) Avail: CFSTI CSCL 12/1

The result of G. V. Zhidkov is carried over to the case of approximation by Fourier-Jacobi sums in the ultraspherical polynomials ((P sub n) superscript (alpha, alpha)) x, alpha > 0.
TAB

N69-36514# RAND Corp., Santa Monica, Calif.
CENTRAL LIMIT THEOREMS FOR MULTINOMIAL SUMS
Carl N. Morris May 1969 72 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-688822; RM-6026-PR) Avail: CFSTI CSCL 12/1

A central limit theorem is proved for certain statistics of a multinomial random variable. These statistics include Pearsons chi-square test statistic and the likelihood ratio test statistic for simple hypotheses. The feature that distinguishes the results of this work from others is that the limit is taken as the number of multinomial cells become large. Author (TAB)

N69-36520*# Techtran Corp., Glen Burnie, Md.
STOCHASTIC PROBLEMS OF ROCKET DYNAMICS [STOKHASTI ZADACHI RAKETODINAMIKI]
Yu. P. Plotnikov Washington NASA Sep. 1969 20 p refs
Transl. into ENGLISH from IFAC Tech. Session no. 49 p 84–100
(Contract NASw-1695)
(NASA-TT-F-12491) Avail: CFSTI CSCL 12A

A method is proposed that incorporates the step-by-step solution of a problem by breaking it down into two basic parts. The first is the problem of programming optimal motion, where the forces and motion are partially known and the remaining forces and motion must be found so that the motion will possess optimal properties determined before hand. The second basic problem is the determination of the law of the processing of information concerning perturbed motion so that the control selected will damp this motion to the extent which is greatest, and where control will depend explicitly only on the measured coordinates of the process. Author

N69-36525# Naval Research Lab., Washington, D.C.
TABLES OF ASSOCIATED LEGENDRE FUNCTIONS OF THE FIRST AND SECOND KIND OF VERY LARGE DEGREE WITH ARGUMENTS NEAR UNITY
S. Hanish, R. V. Baier, R. L. Berkowitz, A. L. Van Buren, and W. H. Buckler Jun. 1969 58 p refs
(AD-690866; NRL-6678) Avail: CFSTI CSCL 12/1

Formulas useful for the numerical calculation of small-order and very-large-degree associated legendre functions of the first and second kind, P (superscript M subscription N) (X) and Q (superscript M subscript N) (X), together with their first derivatives, are listed and explained. A digital computer printout of 2560 entries of these functions for arguments close to unity, previously unpublished, is reproduced. The ranges of parameters M, N, and X covered in these tables are: M = 0(1)2, N = 0(1)79, and X = 1.1, 1.01, 1.001, 1.0001, 1.00001, 1.000001, 1.0000001, and 1.00000001. Author (TAB)

N69-36632# Bell Aerosystems Co., Buffalo, N.Y.
ADAPTIVE NONLINEAR MODELING WITH QUANTIZERS Annual Progress Report, 15 Jun. 1968–14 Jun. 1969
Frederic D. Powell 14 Jun. 1969 60 p refs
(Contract Nonr-4864(00))
(AD-688194; BA-9500-920158) Avail: CFSTI CSCL 12/1

Identification of the dynamics of a nonlinear plant was studied using the combination of a generalized, or equation-error, modeler with multilevel quantizing for piecewise-linear modeling. Algorithms for adapting the quantizing boundary locations and the modeling weights are derived. Conditions are established which allow converting a least mean square error-correcting training algorithm for the modeling weights to a modified forced-learning algorithm which converges as rapidly as the signal statistics permit. Experimental results indicate that this type of modeler converges more rapidly than the ordinary types of nonlinear modelers, and to a more accurate solution. Author (TAB)

N69-36639# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
PROPERTIES OF BOUNDS ON COMPUTATIONS
A. R. Meyer and E. M. Mc Creight Apr. 1969 14 p refs
(Contract F44620-67-C-0058)
(AD-688241; AFOSR-69-1307TR) Avail: CFSTI CSCL 12/1

Partial recursive functions which equal the amount of time or space required by computations have special properties which distinguish them from arbitrary partial recursive functions. Our main result illustrates a property of running times similar in interpretation to Borodins gap theorem. The proof is based on the construction of difficult to compute characteristic functions which take the value one very infrequently. Author (TAB)

N69-36643# Imperial Chemical Industries, Ltd., Millbank (England).
PROGRAMMING UNDER LINEAR EQUALITY AND INEQUALITY CONSTRAINTS
R. Fletcher Jan. 1968 15 p refs
(MSDH/68/19) Avail: CFSTI

The development of Davidon's method for unconstrained minimization to optimize nonlinear functions subject to linear inequality and equality constraints is discussed. Both methods are improvements on Rosen's original method which involved projecting steepest descent directions and suffered from the usual oscillatory behaviour. The theory is presented for some of the special cases, as these bear considerably on the general case. It is shown that although the appropriate course of action for equality constraints is known, this is not so for inequality constraints. An algorithm differing significantly from that of Goldfarb has been produced and used successfully on ill-conditioned problems in chemical engineering. Author

N69-36711# Radio Corp. of America, Princeton, N.J.
CHOW PARAMETERS IN THRESHOLD LOGIC
Robert O. Winder Apr. 1969 54 p refs
(Contract F19628-68-C-0070)
(AD-688918; SR-2; AFCRL-69-0219) Avail: CFSTI CSCL 9/2

The report is a broad treatment of Chow parameters – a set of n+1 integers which can be abstracted from any given n-argument switching function. Basic properties and alternative definitions of these numbers are established, and correlated with earlier work of Golomb, Ninomiya, Chow, Hawkins, Coleman, Kaplan, Kaszerman, Dertouzos, and the author. These earlier works provide numerical characterizations of switching functions generally, and with respect to threshold functions, they provide the optimal test-synthesis method for completely specified 7-argument (or less) functions, reflect the signs and relative magnitudes of realizing weights and threshold, and can be used themselves as approximating weights. Results are reproved in a uniform notation, including Ninomiyas bound on the sum of squares of Chow parameters. Author (TAB)

N69-36715# Illinois Univ., Urbana. Antenna Lab.
ON THE SOLUTION OF A GENERALIZED WIENER-HOPF EQUATION
R. Mittra and S. W. Lee 6 Apr. 1969 29 p refs
(Contract F19628-69-C-0015)
(AD-688917; SR-1; AL-R-69-4; AFCRL-69-0166) Avail: CFSTI CSL 12/1

The paper deals with the generalized Wiener-Hopf equation: G(alpha) X+(alpha) + H(alpha) X+(-alpha) - Y-(alpha) + psi(i)(alpha) = 0, tau sub 1 < tau < tau sub 2 where alpha = (sigma + i tau) is a complex variable; G(alpha), H(alpha), and psi (i)(alpha) are known functions; and, X+(alpha), Y-(alpha) are unknowns, analytic in upper and lower half planes respectively, as

indicated by their respective subscripts. This type of equation arises in a class of boundary value problems in electromagnetic theory the geometries of which may be described as modified Wiener-Hopf type. The method of approach, which is fundamentally different than those currently available in the literature, is based on a pairing of singularities in the complex alpha-plane. This leads to a functional equation which is exactly solvable in its asymptotic form. The knowledge of this solution permits one to employ one of several rapidly converging numerical procedures available in the literature for a more accurate solution. Two examples illustrating the application of the procedure are included in the paper. Author (TAB)

N69-36722# Raytheon Co., Wayland, Mass. Advanced Development Lab.
STUDY OF NATURAL INVARIANCE IN ELECTROMAGNETIC THEORY Final Report, 1 Jan. 1965–30 Sep. 1967
Asim Yildiz Sep. 1968 168 p refs
(Contract AF 19(628)-4380)
(AD-688216; AFCRL-69-0063) Avail: CFSTI CSCL 12/1

The practical information needed in the transformation theory of physics is presented; some alternatives to traditional approaches towards introducing nonlinear coordinates into physics are given. Furthermore, we discuss the transcription of the differential expressions of physics into terms of comitants and concomitants. The final tabulated material is arranged to contain the necessary information for the traditional curvilinear method as well as useful items of information needed when employing the alternatives based on the theory of differential comitants and differential concomitants. Author (TAB)

N69-36750# Texas Univ., Austin. Computation Center.
A COMPARISON OF FIVE NUMERICAL METHODS FOR SOLVING POLYNOMIAL EQUATIONS WITH REAL COEFFICIENTS
John L. Smallwood (M.A. Thesis) Jan. 1969 127 p refs
(Contract DA-ARO(D)-31-124-G1050; Grant NSF GP-8442)
(AD-688947; ITR-19; AROD-3772.42-M) Avail: CFSTI CSCL 12/1

The report describes and compares five numerical methods for finding the zeros of polynomials having real coefficients. It is designed to serve as an aid to anyone desiring to study currently favored methods in this area and as a guide to those who must select a method for their own computational use. It includes a detailed description of each of the five methods and a comparison of the actual computational effectiveness of those methods. Author (TAB)

N69-36751*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NUMERICAL RESEARCH FOR THE BURGERS' MODEL TURBULENCE BASED ON THE CHARACTERISTIC FUNCTIONAL FORMALISM
Iwao Hosokawa and Kiyoshi Yamamoto Sep. 1968 43 p refs Submitted for publication
(NASA-TM-X-63661; X-641-69-392) Avail: CFSTI CSCL 12A

The one dimensional Burgers model of turbulence is investigated by computing the functional integral expression for the correlation function, based on the Hopf theory of statistical hydromechanics, with the aid of a high speed computer. The initial probability distribution of the velocity is assumed to be normal with zero mean and with a Gaussian covariance function. The manner in which the energy decay curve changes under variation of the Reynolds number R implies the existence of a certain asymptotic curve for $R \to \infty$. The values obtained for the correlation function at some instants indicate the inverse square law for the energy spectrum holds in some wave number range for high values of R. Author

N69-36771# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
NEWTON'S METHOD IN DISCRETE-TIME NONLINEAR DATA SMOOTHING
J. S. Meditch Apr. 1969 18 p refs
(AD-688258; D1-82-0837; ISR-27) Avail: CFSTI CSCL 12/1

It is well known that the problem of estimating the state and parameters of discrete-time nonlinear dynamic systems from noisy measurements can be formulated as a nonlinear two-point boundary-value problem. In this paper, an algorithm is developed for solving the above boundary-value problem. The algorithm, which is based on Newtons method, requires very little storage. A detailed discussion of the algorithm is given and certain extensions of it are indicated. Author (TAB)

N69-36811# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON SUFFICIENT TESTS OF CONVERGENCE OF THE METHOD OF AVERAGING FUNCTIONAL CORRECTIONS
Yu. D. Sokolov 10 Apr. 1969 21 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 17, no. 3, 1965 p 91–103
(Contract NOw-62-0604-c)
(AD-688285; APL-CLB-3-T-582) Avail: CFSTI CSCL 12/1

In the iterative solution of the nonlinear functional equation x = T(x) + phi on a function space, the authors method of averaging functional corrections is defined by the sequence y sub n = T(y sub (n-1) + (alpha sub n)Z) + phi, where z is a fixed function, alpha sub n is a scalar satisfying L (y sub n) - L (y sub (n-1)) + (alpha sub n) L z, and L is a fixed linear functional on the function space. Sufficient conditions are obtained for the convergence of this method as applied to systems of integral equations of the Hammerstein type. The results are related to the previous work of Kurpel. Author (TAB)

N69-36812# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON APPROXIMATION IN THE MEAN BY ANALYTIC FUNCTIONS
V. G.Mazya et al 11 Mar. 1969 26 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), v. 23, no. 13/3, 1968 p 62–74
(Contract NOW-62-0604-c)
(AD-688284; APL-CLB-3-T-577) Avail: CFSTI CSCL 12/1

Let E be an open set in the complex plane and let G be a domain containing E. This paper is devoted to the investigation of conditions ensuring the possibility of the approximation in the L sub p -metric of functions analytic in E by functions analytic in G. Author (TAB)

N69-36840# Louisiana State Univ., Baton Rouge. Coll. of Engineering.
APPLYING FEEDFORWARD CONTROL Interim Technical Report
John A. Miller, Paul W. Murrill, and Cecil L. Smith Jun. 1969 42 p refs
(Contract F44620-68-C-0021; Proj. Themis)
(AD-688798; THEMIS-LSU-T-TR-8; AFOSR-69-1417TR) Avail: CFSTI CSCL 12/1

Feedforward control is an advanced control technique which has become increasingly important as the demand for better control has grown. This article will review previous work and illustrate the main concepts of feedforward control. The first part

will qualitatively compare feedforward control (FFC) and feedback control in order to answer the question What is FFC. In the second part the advantages and disadvantages of using feedforward control will be discussed to answer the question Why and when to use FFC. In the next section previous work on feedforward control will be surveyed. The different types of feedforward controllers and how they are mathematically developed will then be illustrated with several examples. This report therefore summarizes the current state-of-the-art on the whats, whys, and hows of applying feedforward control. Author (TAB)

N69-38895# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
SEPARATION AND SUPPORT PROPERTIES OF CONVEX SETS: A SURVEY
Victor Klee May 1969 58 p refs
(Contract N00014-67-A-0103)
(AD-689357; TR-13; DI-82-0842) Avail: CFSTI CSCL 12/1

Separation and support properties of convex sets are widely recognized as natural and important tools in the theory of optimal control. The present report provides a comprehensive survey of such properties, going far beyond those that have actually been applied in control theory up to the present time. The discussion is entirely in the neutral language of convexity theory and thus should be useful to workers in the many other areas (in addition to control theory) in which separation and support properties have been applied. Author (TAB)

N69-38898# Imperial Chemistry Industries, Ltd., Wilmslow (England). Central Management Services.
REVIEW OF CONSTRAINED OPTIMIZATION
D. Davies and W. H. Swann 30 Sep. 1968 21 p refs
(MSDH/68/131) Avail: CFSTI

The solving of constrained optimization problems are reviewed from the standpoint of methods of approach. These methods are divided into two basic categories: function modification followed by unconstrained optimization, and direction modification without altering the function. The methods under the former category seek to define a function that has an unconstrained optimum at the same point as the optimum of the given constrained problem. Optimization of this new function will then define the required change in the search direction. The latter category's methods attempt to follow a constraint while others try to rebound from them and so continue the search in the feasible region. The advantages and disadvantages of each method are given, and finally a preferable method is suggested. Author

N69-38899# Sheffield Univ. (England) Dept. of Probability and Statistics.
ANALYSIS OF DISTRIBUTIONS ON A SPHERE BY THE METHODS OF INVERSE PROBABILITY
J. B. Garner Oct. 1968 36 p refs
(RR-49/JBG-2) Avail: CFSTI

The problem of distribution on a sphere is analyzed from a Bayesian viewpoint. Both the problem of the observation vectors clustering about a direction, and clustering about an axis are considered. By conventional Bayesian analysis the estimation distributions in the former case are found. Tests of the usual null hypotheses are constructed in the form of Bayes factors. Some of these tests fail to have the property of giving a Bayes factor of one on the evidence of a sample of size one. This may be due to the use of an over simple prior distribution. The Bayes factors for size two or larger appear to be consistent. Author

N69-38903 Missouri Univ., Columbia.
GENERALIZED UNCERTAINTY FUNCTIONS AS APPLIED TO MEASUREMENT SELECTION
Dennis Lee Tebbe (Ph. D. Thesis) 1968 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-3288

The measurement selection problem of pattern recognition, the application of uncertainty functions to this problem, and the fundamental properties and definition of uncertainty function are examined. Pattern recognition is taken to be a special type of decision theory problem, namely a finite classification problem. Uncertainty functions are defined as generalizations of Shannon's entropy function. The formulation of the measurement selection problem is shown to involve a principle of choice which specifies a selection criterion, and the Utopian principle which prescribes minimizing Bayes risk is proposed. It is pointed out that the obvious solution of measurement selection involves certain prohibitive prerequisites, one of which is knowledge of the joint underlying distribution. Lack of such knowledge indicates the desirability of utilizing only lower order distributions. It is illustrated that there are situations in which there is absolutely no way of utilizing only lower order distributions. The idea of selecting measurements so as to minimize the conditional uncertainty is considered in the context of a generalized uncertainty function. Dissert. Abstr.

N69-38904 Brandeis Univ., Waltham, Mass.
CORRELATION EFFECTS IN NARROW ENERGY BAND MATERIALS
Donald M. Esterling (Ph.D. Thesis) 1968 71 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-2052

A mass operator perturbation scheme devised on the principle that the role of kinetic energy as a breaker of degeneracy must be accounted for is presented. A sort of Taylor's expansion of the mass operator in terms of the kinetic energy is found, the coefficients of which are functionals of the exact Green's functions at zero kinetic energy. The ambiguity due to the degeneracy is removed from these functions self consistently and thereby the degeneracy properly treated. A Green's function which accounts for all first order effects of the kinetic energy is also given. Dissert. Abstr.

N69-38916# Genge Industries, Inc., Sherman Oaks, Calif. Scientific and Consulting Div.
PREDICTION-ALLOCATION-MATHEMATICAL MODELING MAINTAINABILITY (M) QUANTITATIVE DESIGN PARAMETERS
George W. Dauncey [1969] 21 p refs
(AD-688723) Avail: CFSTI CSCL 15/5

This presentation is a challenging Maintainability (M)Engineering discipline technique which provides a dynamic and simplified method for management viability of the maintenance action times and frequency of maintenance tasks involved in the establishment of the M quantitative constraints required to be designed into system equipments. The prediction technique is used to develop the M design parameters of means and maximum times and the standard deviation of maintenance times requirements and allocations to be designed into equipments to satisfy the operational mission downtime constraints imposed or desired. The effectivity of the predictions of these basic parameters is shown to be the basic requirements for the establishment of the Integrated Logistic Support (ILS) planning and its associated minimization of the life cycle support costs. The visibility provides a basis for evaluation of the M/ILS demonstrations and the design changes effects on the M constraint requirements. Author (TAB)

N69-36923*# National Aeronautics and Space Administration. Ames Research Enter, Moffett Field, Calif.
CHEBYSHEV SERIES SOLUTION OF NONLINEAR ORDINARY DIFFERENTIAL EQUATIONS: INITIAL-VALUE PROBLEMS
Kin L. Lee and Paul F. Byrd Washington Sep. 1969 77 p refs
(NASA-TM-X-1882 Avail: CFSTI CSCL 12A

The approximate Chebyshev series solution of nonlinear ordinary differential equations based on Picard iteration is discussed. Detailed algorithms are provided for the numerical solution of initial-value problems involving (a) a system of n first-order nonlinear differential equations, and (b) an nth-order nonlinear differential equation. Methods to accelerate the convergence of the iterative procedures are also proposed. FORTRAN 4 subroutines for the algorithms with options for accelerating convergency are given. Author

N69-36927# Louisiana State Univ., Baton Rouge. Coll. of Engineering.
INPUT EXCITATION EFFECTS ON EXPERIMENTAL DYNAMIC MODEL DEVELOPMENT Interim Technical Report
Oran A. Ritter, Cecil L. Smith, and Paul W. Murrill Jun. 1969 24 p refs
(Contract F44620-68-C-0021; Proj. Themis)
(AD-688799; THEMIS-LSU-T-TR-9; AFOSR-69-1418TR) Avail: CFSTI CSCL 12/1

The growing application of experimental techniques to the development of dynamic mathematical models has resulted in a need to develop criteria for selecting types and forms of excitations for real system disturbances. The purpose of this report is to examine the response surfaces of a simplified models deviations from a real system in order to determine the types of inputs which give the most readily optimized results and in order to determine the directional effects of the input excitations amplitude and duration on these response surfaces. Author (TAB)

N69-36928# Louisiana State Univ., Baton Rouge. Coll. of Engineering.
COMPARING AND TUNING PI AND PID DIGITAL CONTROL ALGORITHMS Interim Technical Report
Uday D. Shendrikar, Cecil L. Smith, and Paul W. Murrill Jun. 1969 26 p refs
(Contract F44620-68-C-0021; Proj. Themis)
(AD-688795; THEMIS-LSU-T-TR-5; AFOSR-69-1414TR) Avail: CFSTI CSCL 12/1

For years engineers have followed the practice of installing proportional-plus-integral (PI) controllers in the normal control loops and proportional-plus-integral-plus-derivative (PID) controllers in the tough control loops--usually slow loops involving temperature. The typical reason given is that the additional cost of the derivative mode could only be justified in difficult control loops. Another reason is that the PID controller is much more difficult to tune, and engineers would prefer not to undertake it unless necessary. With the advent of direct digital control systems, the increased cost of using a PID algorithm instead of a PI algorithm is negligible, and only the tuning problem remains. Perhaps automated tuning procedures will be perfected in the future to eliminate this problem, but for the present, some guidelines are needed for determining when and how PID and PI algorithms should be used. This report attempts to answer some of these questions about PI and PID algorithms. Author (TAB)

N69-36935# Louisiana State Univ., Baton Rouge. Coll. of Engineering.
APPLICATION OF SIMULATION TO THE GENERALIZED OPTIMIZATION OF PROCESS CONTROL SYSTEMS Interim Technical Report
Paul W. Murrill and Cecil L. Smith Jun. 1969 19 p refs
(Contract F44620-68-C-0021; Proj. Themis)
(AD-688805; THEMIS-LSU-T-TR-15; AFOSR-69-1424TR) Avail: CFSTI CSCL 12/1

For the past five years, the authors have been engaged in various aspects of the design of control systems. Virtually all of the studies required, in one way or another, the solution to the differential equations describing the controller and the system being controlled. This aspect of the problem falls into the general area of simulation. This paper describes the experiences of the authors in their use of various simulation techniques, including digital simulation languages, FORTRAN, and the analog computer. Author (TAB)

N69-36937# Louisiana State Univ., Baton Rouge. Coll. of Engineering.
AN ADVANCED TUNING METHOD Interim Technical Report
Alfredo M. Lopez, Cecil L. Smith, and Paul W. Murrill Jun. 1969 28 p refs
(Contract F44620-68-C-0021; Proj. Themis)
(AD-688791; THEMIS-LSU-T-TR-1; AFOSR-69-1410TR) Avail: CFSTI CSCL 12/1

Essentially all past techniques use a model composed of a first order lag plus dead time, the parameters being the gain, the time constant, and the transport lag or dead time. Another technique primarily intended for underdamped systems is based on a model composed of a second order system. If a second-order lag plus dead time model were used instead, an additional dynamic constant is included and the resulting representation of the real system should improve correspondingly. The objectives of this report are to present a complete tuning technique based on this type of model and to show how it is superior to other tuning techniques. Author (TAB)

N69-36943 Illinois Univ., Urbana.
OPTIMIZATION OF SYSTEMS CONTAINING DISCONTINUOUS ELEMENTS
Robert Gerald Stefanek (Ph.D. Thesis) 1968 98 p
Avail: Univ. Microwaves: HC $5.00/Microfilm $3.00 Order No. 69-1462

The uses of the sensitivity equations for systems containing discontinuous elements in solving various optimization problems are discussed. Known results about the first order sensitivities are employed in an iterative procedure proposed for the solution of two-point boundary value problems for systems described on different time intervals by different non-linear vector differential equations. The procedure, which involves the use of Newton's method, is demonstrated for fixed-time, fixed-end-point fuel optimization for linear time-varying plants with a bounded control. With modifications, the iterative procedure can also be used for solution of various free-time optimization problems involving a bounded control. An on-line method of sub-optimal control is proposed for the case of fixed-time, fixed-end-point fuel optimization when the control is bounded and various parameters are known only to be near nominal values. The method of control is also applicable when some combination of fuel and time is to be minimized. Finally, a study is made of parameter optimization for a system containing a relay with hysteresis and dead zone. Under certain assumptions, the second order sensitivity equations are derived and the Newton-Raphson method is employed for the minimization of the chosen performance index. Dissert. Abstr.

N69-36944 Purdue Univ., Lafayette, Ind.
ON THE APPLICATION OF THE POTENTIAL FUNCTION METHOD TO PATTERN RECOGNITION AND SYSTEM IDENTIFICATION

Ronald Robert Lemke (Ph.D. Thesis) 1968 187 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-2946

The potential function method is discussed in considerable detail to show how the two types of potential functions differ. Formation of the potential function in K variables is discussed. Probability densities are estimated with the potential function method, and upper bounds on the error are given for the potential function formed from some common orthonormal systems. When applying the potential function method, the range of data is necessary information as the approximations are better if the minimum interval is used. Both unimodal bimodal densities are estimated from the data. The memory requirements of two forms (types) of the potential functions are discussed when applied to pattern classification. Also the computational time required for classification is given. Complete separation of the training set can be obtained by proper choice of the potential function and its parameters. However the computational complexity and memory requirements increase. Application of the method to system identification is accomplished by converting the system identification problem to a pattern recognition problem. A piece-wise linear model is shown to reduce the mean square error considerably. The experimental determination of the optimum weighting of the input components is performed and compared to previous models. Dissert. Abstr.

N69-36947 Virginia Univ., Charlottesville.
A THREE STAGE CHARACTER RECOGNITION SYSTEM
Edward Alton Parrish, Jr. (Ph. D. Thesis) 1968 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-18228

A character recognition machine that is insensitive to translation and, to a lesser degree, dilations and angular orientation of the input samples is described. The system consists of three stages: (1) a receptor to make certain measurements on the input patterns to be classified; (2) a preprocessor to subdivide the pattern set into sixteen subsets; and (3) a categorizer to separate the members of the individual subsets. It is shown that the nonlinear discriminant functions of the preprocessor, as determined by Bayes' strategy, may be linearized subject to the relaxation of the requirements for optimality. The categorizer is an implementation of strictly linear discriminant functions (that is, the decision surfaces are separated by hyper-planes), resulting in a completely linear machine. The recognition system has been simulated on a computer, the results of which are presented and evaluated. The direction of future research effort is suggested. Dissert. Abstr.

N69-36969# Sheffield Univ. (England). Dept. of Probability and Statistics.
ANALYSIS OF THE DISTRIBUTION OF DIRECTIONS IN TWO DIMENSIONS BY THE METHODS OF INVERSE PROBABILITY
J. B. Garner Oct. 1968 39 p refs
(RR-48/JBG-1) Avail: CFSTI

A Bayesian approach to the distribution of directions in two dimensions is presented, and cases where vectors are clustered about a common pole and where they cluster about a common axis are discussed. Estimates and estimation distributions are found. Tests are devised for null hypotheses in the form of Bayes factors. Failures are discussed; however, for sample sizes of two or larger the tests appear to give answers consistent with common sense. F.O.S.

N69-36975# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE AVERAGING PRINCIPLE IN NONLINEAR MECHANICS AS APPLIED TO COUNTABLE SYSTEMS OF EQUATIONS
O. A. Zhautykov 13 Mar. 1969 18 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 17, no. 1, 1965 p 39–46
(Contract NOw-62-0604-c)
(AD-688286; APL-CLB-3-T-583) Avail: CFSTI CSCL 12/1

The averaging technique of Krylov-Bogolyubov is applied to countable systems of equations of the form d(x sub k)/dt = epsilon (f sub k)(t,x sub 1, x sub 2,...) (k = 1,2,...). The results are summarized in a theorem. TAB

N69-36977# Wake Forest Coll., Winston-Salem, N.C. Dept. of Mathematics.
BOUNDS FOR CHARACTERISTIC ROOTS OF MATRICES
Final Scientific Report
Alfred T. Brauer 17 Mar. 1969 5 p refs
(Grant AF-AFOSR-982-67)
(AD-686107; AFOSR-69-1036TR) Avail: CFSTI CSCL 12/1

The report discusses various highlights of the fifteen or so mathematical papers resulting from AFOSR support of the principal investigators research efforts in the area of Bounds for Characteristic Roots of Matrices. Author (TAB)

N69-36992# Illinois Univ., Urbana. Coordinated Science Lab.
A PROBE OF TUTTE'S REALIZABILITY CONDITION
Wataru Mayeda May 1969 23 p refs
(Contract DAAB07-67-C-0199)
(AD-688834; R-416) Avail: CFSTI CSCL 12/1

The paper gives a simple proof of the Tuttes realizability condition for a cut-set (circuit) matrix of a non-oriented graph. First, a minimum non-realizable matrix is defined as a matrix (N U) which satisfies (1) (N U) is not a cut-set (circuit) matrix, (2) (N U) does not satisfy the conditions in the Tuttes theorem, and (3) deleting any column other than that belongs to a unit matrix or any row of any normal form of (N U), the resultant matrix is realizable as a cut-set (circuit) matrix. A proof of the Tuttes theorem in this paper is accomplished by showing that minimum non-realizable matrices do not exist. Author (TAB)

N69-37001# Sheffield Univ. (England). Dept. of Probability and Statistics.
MARKOVIAN TRANSITION PROBABILITY MATRICES FROM A SEMIGROUP POINT OF VIEW
M. S. Bingham Jul. 1968 33 p refs
(RR-47/MSB-2) Avail: CFSTI

The problem of integral representation of the probability transition matrix of a Markov chain with finite number of states is considered. Although analytical representations for the elements of such matrices have been produced previously, the present paper illustrates a completely different approach to the problem. The methods that are used belong to the theory of infinitely divisible probability distributions. Author

N69-37008# Israel Inst. of Tech., Haifa. Faculty of Industrial and Management Engineering.
OPTIMIZATION OF INSPECTION POLICIES BY CLASSICAL METHODS
Z. Kander and P. Naor Apr. 1969 22 p refs *Its* Operations Res., Statistics and Econ. Mimeograph Ser. No. 38
(Contract F61052-68-C-0014)
(AD-688919) Avail: CFSTI CSCL 14/4

Inspection models deal with operating systems whose stochastic failure is detected by observations carried out intermittently. Previous authors calculated an optimal policy for a system possessing a given life time distribution. In these models two types of cost are introduced: one pertains to the expense incurred for each check; the other is associated with the time which elapses between system failure and its discovery at the subsequent check.

The optimal policy is a sequence of checking times minimizing the loss per life cycle or, alternatively, per time unit. The technique of differentiation is used in order to arrive at the minimal loss solution. The present study deals with some additional models; in particular: (a) a truncated inspection model, in which costs for both unscheduled and scheduled replacements are introduced. The optimal policy is then given by a finite time sequence. (b) mixed models in which monitoring is considered in addition to checking. It is demonstrated by numerical results that the use of these policies will generally result in smaller losses than those associated with previous models. Author (TAB)

N69-37009# Louisiana State Univ., Baton Rouge. College of Engineering.
PROPORTIONAL CONTROL SYSTEMS
Uday D. Shendrikar, Cecil L. Smith, and Paul W. Murrill Jun. 1969 19 p refs
(Contract F44620-68-C-0021; Proj Themis)
(AD-688794; AFOSR-69-1413TR; LSU-T-TR-4) Avail: CFSTI CSCL 12/1

The basic objective of most engineering endeavors is to accomplish a stated objective with a minimum expenditure of funds, which in many cases reduces to using the simplest configuration that meets the requirements. The simplest control system is, of course, the proportional or gain-only controller. The design of such controllers for continuous systems using frequency domain concepts is well-treated in classical servomechanisms texts. However, the design of such systems in the time domain using minimum error integrals has not been so well-treated. This report discussed the design of proportional controllers for sampled-data control systems using the error integrals as a design criteria. Both the classical servomechanism (set point) and regulator (disturbance) problems are treated. Three different error integrals are used, with two different modifications to make them converge. Some advantages of proportional over proportional integral (PI) and proportional-integral-derivative (PID) controllers are cited. Author (TAB)

N69-37016# Imperial Chemistry Industries, Ltd., Wilmslow (England). Central Management Services.
AN ALGORITHM FOR OPTIMISATION SUBJECT TO LINEAR INEQUALITIES
R. Fletcher 30 Sep. 1968 20 p refs
(MSDH/68/130) Avail: CFSTI

Described is an algorithm for minimizing a function $F(x)$ of n variables x subject to m linear constraints $Cx \geq d$ where C is a matrix of columns $c_1, c_2 \ldots c_m$, each one corresponding to a normal to one of the linear constraints. The performance of the algorithm on a wide range of problems is also analysed. The method is based on Davidon's method for unconstrained optimization as adapted to deal with linear equality constraints, together with a device for deciding which of the inequality constraints can be regarded as equalities. Author

N69-37017*# Texas Univ., Austin. Dept. of Electrical Engineering.
ON FIXED LINEAR SYSTEMS WITH A GENERALIZED PERFORMANCE CRITERIA
R. P. Rhoten, J. K. Aggarwal, and N. H. Mc Clamroch (Mich. Univ., Ann Arbor) Nov. 1967 16 p refs
(Contract NASB-18120; Grants AF-AFOSR-766-66; NSF GK-281)
(NASA-CR-61499; EMRL-RM-1042) Avail: CFSTI CSCL 12A

This paper considers optimization and sensitivity problems as related to a fixed linear system with a generalized performance criteria. A technique is used which solves for the performance index as a polynomial in the system initial conditions. The method is not restricted to quadratic form loss functions, but applies to any index whose integrand is the product of a time function and a homogeneous polynomial in the states and controls. Author

N69-37025*# Brown Univ., Providence, R.I. Division of Applied Mathematics.
BOCHNER'S THEOREM IN INFINITE DIMENSIONS
P. L. Falb and U. Haussmann [1968] 27 p refs
(Grants NGL-40-002-015; NSF GK-2788)
(NASA-CR-105750) Avail: CFSTI CSCL 12A

Let G be a locally compact abelian group. A well-known theorem of Bochner states that a mapping ψ of G into C is positive, definite, and continuous if and only if there is a unique nonnegative finite regular Borel measure m on $\hat{G}$ (the dual group of G) such that $\psi(g) = \int_{\hat{G}} (\gamma, g) dm$ where (γ, g) denotes the action of the character γ on g. An alternate version of the theorem states that if A is a semi-simple, self-adjoint, commutative Banach algebra and ψ is a linear functional on A, then ψ is positive and extendable if and only if there is a finite positive Baire measure $\hat{\alpha}$ is the Gelfand transform of $\alpha \in A$. These theorems are extended to mappings taking values in a Banach space X. The results generalize the extension of Bochner's theorem. Several examples of spaces to which the theory applies are given. Author

N69-37027# Sheffield Univ. (England). Dept. of Probability and Statistics.
STONE'S THEOREM AND COMPLETENESS OF ORTHOGONAL SYSTEMS
B. D. Craven Nov. 1968 25 p
(RR-50/BDC-1) Avail: CFSTI

The use of the Stone–Weierstrass approximation theorem to prove the completeness of various systems of orthogonal polynomials, e.g. Chebyshev polynomials, is presented. Stone's theorem is used to prove a more general completeness theorem, which includes as special cases Plancherel's theorem, the corresponding theorem for Hankel transforms, the completeness of various polynomial systems, and certain expansions in Jacobian elliptic functions. The essential feature common to all these systems is shown to be a certain algebraic structure; if S is an appropriate vector space spanned by orthogonal functions, then the algebra A generated by S is contained in the closure of S in a suitable norm. Author

N69-37033*# California Univ., Berkeley. Electronics Research Lab.
TOWARD A THEORY OF FUZZY SYSTEMS
L. A. Zadeh Washington NASA Sep. 1969 40 p refs
(Grant NGL-05-002-016)
(NASA-CR-1432; ERL-69-2) Avail: CFSTI CSCL 12A

The systems encountered in the real world which are too complex and/or too ill-defined to be susceptible of exact analysis are investigated. The concept of a fuzzy set, that is, a class which admits of intermediate grades of membership in it, opens the possibility of analyzing such systems both qualitatively and quantitatively by allowing the input and/or the output and/or the state of the system to range over fuzzy sets. Several basic concepts relating to the characterization of discrete-time fuzzy systems are introduced, and input-output-state equations for such systems are developed. Author

N69-37039 Illinois Univ., Urbana.
SINGULAR PERTURBATION METHOD IN THE THEORY OF OPTIMAL CONTROL
Peddapullaiah Sannuti (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-1435

A method called Optimally Sensitive Design is developed. This method allows an improvement of the result of a low-order design by using low-order models only. It accepts the low-order design at the beginning of the design procedure and then improves the obtained result by adding an optimally sensitive term to the low order-optimal control. This term is the first variation of the high-order-optimal control due to the change in system order. For the computation of the optimally sensitive control the singular perturbation theory is used. Several examples worked out illustrate the practical applicability and computational simplicity of the optimally sensitive design method. Dissert. Abstr.

N69-37043# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
REGULARITIES IN CONGRUENTIAL RANDOM NUMBER GENERATORS
George Marsaglia May 1969 8 p ref *Its* Mathematical Note No. 601
(AD-689295; D1-82-0844) Avail: CFSTI CSCL 12/1

The paper suggests that points in n-space produced by congruential random number generators are too regular for general Monte Carlo use. Regularity was established previously for multiplicative congruential generators by showing that all the points fall in sets of relatively few parallel hyperplanes. The existence of many containing sets of parallel hyperplanes was easily established, but proof that the number of hyperplanes was small required a result of Minkowski from the geometry of numbers--a symmetric, convex set of volume 2 to the nth power must contain at least two points with integral coordinates. The present paper takes a different approach to establishing the course lattice structure of congruential generators. It gives a simple, selfcontained proof that points in n-space produced by the general congruential generator r sub (i+1) is identically equal to a(r sub i) + b mod m must fall on a lattice with unit-cell volume at least m to the power (n-1). There is no restriction on a or b; this means that all congruential random number generators must be considered unsatisfactory in terms of lattices containing the points they produce, for a good generator of random integers should have an n-lattice with unit-cell volume 1. Author (TAB)

N69-37050# Hebrew Univ., Jerusalem (Israel). Dept. of Mathematics.
RESEARCH IN MATHEMATICAL ANALYSIS Final Scientific Report, 1 Dec. 1965 - 31 Mar. 1969
Shmuel Agmon Jun. 1969 30 p refs
(Grant AF-EOAR-18-66)
(AD-689284; AFOSR-69-1447TR) Avail: CFSTI CSCL 12/1

The report contains results obtained by S. Agmon, A. Dvoretzky, S. Foguel, S. Kaniel and J. Lindenstrauss in various areas of mathematical analysis. TAB

N69-37051# Louisiana State Univ., Baton Rouge. College of Engineering.
FORMULATING THE LEAST-SQUARE REGRESSION FOR CONTINUOUS ANALYSIS
Charles F. Moore, Cecil L. Smith, and Paul W. Murrill Jun. 1969 29 p refs
(Contract F44620-68-C-0021; Proj Themis)
(AD-688802; LSU-T-TR-12; AFOSR-69-1421TR) Avail: CFSTI CSCL 12/1

Numerous techniques have been developed to adapt to changes in process parameters, most of which require the system to be taken off control and disturbed so that data may be collected for either on-line or off-line analysis. These techniques in many cases cannot be justified even though adaptive modeling is needed. The requirement that the process be intentionally disturbed in most cases is undesirable and frequently completely impractical. Also, the actual computer programs required to perform the analysis are generally long both in execution time and computer storage. This report demonstrates that in most cases these requirements are not necessary for either on-line or off-line analysis and that the regression problem can be formulated so that changes in model parameters can be continually monitored under normal controlled operation without extensive use of valuable computer time or storage. Author (TAB)

N69-37052# Louisiana State Univ., Baton Rouge. College of Engineering.
AN OPTIMAL CONTROLLER FOR MULTIVARIABLE SYSTEMS SUBJECT TO DISTURBANCE INPUTS
Cecil L. Smith and Paul W. Murrill Jun. 1969 17 p refs
(Contract F44620-68-C-0021; Proj Themis)
(AD-688803; LSU-T-TR-13; AFOSR-69-12122TR) Avail: CFSTI CSCL 12/1

Most industrial processes have two features in common: (1) they are multivariate in nature and (2) they are subject to unmeasured disturbances for which control systems must be installed. The conventional design of multivariable systems has been considered by Bollinger and Lamb, Dahlin et. al and Shinskey. Douglas considered the constrained optimal control of multivariable systems, deriving the optimal switching curves for a representative system. This objective of this work is to present a design technique for linear, continuous controllers for multivariable process systems. The method will use the concepts for the optimal control of linear systems as presented by Athans and Falb. The conventional disturbance control problem is reformulated in a manner that allows optimal control theory to be used directly. Author (TAB)

N69-37055# Indiana Univ., Bloomington. Dept. of Mathematics.
FUNCTION THEORETIC METHODS IN PARTIAL DIFFERENTIAL EQUATIONS
Robert P. Gilbert 1969 334 p refs
(Grants AF-AFOSR-1206-67; AF-AFOSR-400-64)
(AD-688905; AFOSR-69-1533TR) Avail: Academic Press, Inc., New York, $17.50; CFSTI CSCL 12/1

The monograph deals with recent developments in the function theoretic approach to partial differential equations, and application of these developments to certain problems of current interest in mathematical physics. Using the theory of one and several complex variables, the author investigates the analytic behavior of solutions. Other topics discussed are: singular partial differential equations, function theory for solutions of elliptic partial differential equations, generalized Goursat data for nonlinear elliptic partial differential equations, applications to scattering theory. Author (TAB)

N69-37061# California Univ., Los Angeles. Dept. of Mathematics.
UPPER BOUNDS FOR THE ABSCISSA OF STABILITY OF A STABLE POLYNOMIAL
Peter Henrici 1968 13 p refs
(Contracts NONR-233(76); DA-31-124-ARO(D)-355)
(AD-688942) Avail: CFSTI CSCL 12/1

Let n be a positive integer, let a sub 1, a sub 2, ..., a sub n be real numbers, and let p be the polynomial p:z (arrow) z to the nth power + (a sub 1) z to the (n-1) power +...+ a sub n. If the zeros of p are denoted by zeta sub 1, ..., zeta sub n, we call sigma: = max (1 = or < i = or < n) Re (zeta sub i) the abscissa of stability of p. The polynomial p is called stable if and only if sigma < 0. Several lower bounds for the abscissa of stability have been given by G. F. Schrack. The purpose of this paper is to exhibit some negative upper bounds for the abscissa of

stability of a polynomial that is already known to be stable. These bounds are elementary functions of the coefficients. Author (TAB)

N69-37129# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
COHERENT LIFE FUNCTIONS
J. D. Esary and A. W. Marshall Apr. 1969 15 p refs *Its* Mathematical Note No. 596
(AD-688107; D1-82-0833) Avail: CFSTI CSCL 14/4

The life function of a system expresses the life length of the system in terms of the life lengths of its components. This paper illustrates the application of life functions to reliability problems. The principal results are two characterizations of the life functions of coherent systems, which are used to obtain a number of properties for such systems. Author (TAB)

N69-37130# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
MEAN LIFE OF SERIES AND PARALLEL SYSTEMS
Albert W. Marshall and Frank Proschan Apr. 1969 15 p refs *Its* Mathematical Note No. 595
(AD-688106; D1-82-0831) Avail: CFSTI CSCL 14/4

Some inequalities are obtained which yield bounds for the mean life of series and of parallel systems based on the type of component life distributions, such as (a) increasing (decreasing) failure rate; (b) increasing (decreasing) failure rate average; (c) decreasing density; (d) Weibull; (e) Gamma. Similar inequalities are obtained for the convolution of life distributions, helpful in the study of replacement policies. Author (TAB)

N69-37131# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
FORMAL ALGORITHMS FOR CONTINUOUS-TIME NONLINEAR FILTERING AND SMOOTHING
J. S. Meditch Apr. 1969 18 p refs *Its* Inform. Sci. Rept. No. 28
(AD-688108; D1-82-0838) Avail: CFSTI CSCL 12/1

Kalmans formal limiting procedure is applied to some recent results in sequential discrete-time nonlinear filtering and smoothing to obtain the corresponding estimation algorithms for continuous-time nonlinear dynamic systems. The resulting filtering algorithm is found to agree with well-known Detchmendy-Sridhar filter which was obtained via another method. The present smoothing algorithm is a new result. It is argued that the combined filter-smoothing results here lead to an estimation algorithm which is second-order in both system dynamics and measurement function nonlinearity. Author (TAB)

N69-37138# Weibull (Waloddi), Lausanne (Switzerland).
THE EFFICIENCIES OF UNBIASED, LINEAR ESTIMATORS FOR SCALE AND LOCATION PARAMETERS COMPOSED OF ONE, TWO, OR THREE ORDER STATISTICS Summary Report, Feb. 1967 - Feb. 1968
Waloddi Weibull Wright-Patterson AFB, Ohio AFML Apr. 1969 23 p refs
(Contract AF 61(052)-943)
(AD-689407; TSR-2; AFML-TR-69-134) Avail: CFSTI CSCL 12/1

The result of this investigation is, from a practical point-of-view, important in so far as it proves that the procedure of estimating scale and location parameters can be simplified by suppressing a large part of the sample without much loss in efficiency provided that the proper ordered observations are used. These order numbers are presented for estimators composed of one, two, or three observations. It is remarkable that neglecting, for instance, 39 out of 40 observations reduces the efficiency by 35% only. The actual reduction in efficiency, being in many cases quite small when using two or three observations, can be read from the tables. Author (TAB)

N69-37153# Wisconsin Univ., Madison. Mathematics Research Center.
THE LIMITING DISTRIBUTION OF THE SAMPLE OCCUPANCY NUMBERS FROM THE MULTINOMIAL DISTRIBUTION WITH EQUAL CELL PROBABILITIES
B. Harris and C. J. Park Nov. 1968 18 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-689416; MRC-TSR-951) Avail: CFSTI CSCL 12/1

The method of moments is used to exhibit the asymptotic normality of the sample occupancy numbers. Author (TAB)

N69-37170# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
ISOLATION OF THE ROOTS OF A NONLINEAR OPERATOR
A. A. Goldstein (Wash. Univ., Seattle) and F. C. Johnson Jun. 1969 9 p refs
(AD-689391; D1-82-0855; Rept-31) Avail: CFSTI CSCL 12/1

A recurrent problem in optimization theory is the behavior of the system in a neighborhood of a stationary point. A theorem is proven for a class of locally lipschitz operators which gives explicit lower bounds for a neighborhood of a zero of an operator in which the zero is unique. This result is then applied to a problem in minimization with nonlinear constraints obtaining similar results for stationary points. Author (TAB)

N69-37171# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
SEQUENTIAL MODELS IN PROBABILISTIC DEPRECIATION
Yuji Jiri and Robert S. Kaplan 21 Apr. 1969 24 p refs
(Contract NONR-760(24)
(AD-689371; WP-29-68-9; RR-160) Avail: CFSTI CSCL 5/1

Probabilistic depreciation is a method of determining the proper depreciation charge in each year of an assets service life, when the service life is a random variable with known distribution. The paper discusses how the service life distribution is modified as more information is obtained about the actual lifetime of the asset. The problem of determining the proper amount to be charged each year to depreciation while at the same time maintaining the proper balance in the accumulated depreciation account is considered. The analysis is done both for a single asset case and for group depreciation. A final section discusses the use of Bayesian analysis for estimating the particular form of the service life distribution while the assets are in service. Author (TAB)

N69-37173# Weibull (Waloddi), Lausanne (Switzerland).
A CRITERION FOR THE ACCEPTABILITY OF ASSUMED DISTRIBUTIONS Summary Report, Feb. 1968 - Dec. 1968
Waloddi Weibull Wright-Patterson AFB, Ohio AFML Apr. 1969 39 p
(Contract AF 01(052-943)
(AD-689406; AFML-TR-69-124; TSR-9) Avail: CFSTI CSCL 12/1

The usual way to solve the fundamental problem of deciding whether an assumed distribution function is acceptable or not, consists - if at all done - in estimating the parameters and checking the attained goodness of fit by some accepted criterion, in most cases the Chi-square test. In this way, the decision depends not only on the assumed function, so it may happen that an acceptable

function may be rejected on the basis of results from poor estimating or fitting procedures. The purpose of this research was to find a criterion which eliminates such fatalities and depends entirely on the assumed function alone. Such a criterion, based on the number-of-runs has been proposed. The properties of this statistic and its usefulness is a measure of departure from the true distribution have been demonstrated. The concept maximum number of runs (MAXNOR) of a given sample and methods for its ascertaining have been introduced. Its use as a criterion for deciding whether the assumed function is acceptable or not has been studied by applying it to data from tests on strength of brittle materials, fatigue life of aluminum alloys, etc. Author (TAB)

N69-37199# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.
TABLE OF MODIFIED BESSEL FUNCTIONS
Henry E. Fettis and James C. Caslin Feb. 1969 240 p refs
(AD-689394; ARL-69-0032) Avail: CFSTI CSCL 12/1

The report contains 15 place tables of the modified Bessel Functions I sub zero (x), I sub one (x), ((e to the power minus x)I sub zero (x)), ((e to the power minus x) I sub one (x)), for x = 0(001)10. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N69-36081# Dayton Univ. Research Inst., Ohio.
TRACKING ERRORS IN DETAILED WIND SOUNDINGS
Nicholas A. Engler, James K. Luers, John W. Mc Closkey, and Jerry D. Strange Apr. 1969 48 p refs
(Contract F19628-67-C-0102)
(AD-689830; UDRI-TR-69-14; AFCRL-69-0213; SR-1) Avail: CFSTI CSCL 4/2

The rose balloon is a superpressure sphere fabricated of metalized mylar and equipped with a valve to retain the design superpressure as the balloon ascends. It is filled with helium, released, and tracked by a precision radar such as the FPS-16. The purpose is to measure precise winds (and wheare) in thin altitude layers for use in aerospace vehicle structural design as well as a better understanding of the wind fields. In order to fulfill the purposes and objectives of the test, rose and jimsphere balloons were tracked in two different ways. In one phase of the test, balloons were tracked simultaneously by two independent radars. In the other phase, two balloons were released simultaneously with each balloon being tracked by a single radar. (A simultaneous release actually consisted of one balloon being released about two minutes after the other.) In all cases, the servo-bandwidth (SBW) settings of the radars were recorded. Author (TAB)

N69-36106# Freie Univ., Berlin (West Germany). Inst. fuer Meteorology und Geophysik.
METEOROLOGICAL DATA. VOLUME 95, NO. 1: DAILY AND MONTHLY NORTHERN HEMISPHERE 30-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1968 Quarterly Technical Status Report, Jan.-Mar. 1968
Dietrich Just, Barbara Kriester, Karin Labitzke, Renate Lenschow, Karin Petzoldt et al 1969 115 p
(Contract DAJA37-68-C-1104)
(AD-688649; QTSR-1) Avail: CFSTI CSCL 4/1

The reports are published quarterly and present 30 mb maps, day by day, throughout 1961 to present. Height and temperature data are plotted on each chart and appropriate contours are drawn. A discussion of the stratospheric circulation for each quarter is included. Each volume also contains mean monthly maps and charts of changes in the means from month to month, for the appropriate months. Author (TAB)

N69-36110# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HANDBOOK ON THE CLIMATE OF THE USSR. ISSUE 27: KAMCHATKA PROVINCE. PART 2: TEMPERATURE OF AIR AND SOIL
A. P. Katsyka 6 Sep. 1968 222 p Transl. into ENGLISH of the book "Spravochnik po Klimatu SSSR. Vypusk 27: Kamchatskaya Oblast. Chast 2: Temperatura Vozdukha i Pochvy" Leningrad, Gidrometeorol. Izd., 1966 p. 1-184
(AD-685490; FTD-MT-24-185-68) Avail: CFSTI CSCL 4/2

The handbook includes observational materials of meteorological stations, which exist at the present time or existed at some earlier time on the territory of the Kamchatka region. The material is mainly presented for individual stations in the form of tables with explanatory text to each table or group of tables (they are similar in the method of treatment or in the presentation of the materials in them). In the section on air temperature, a certain part of the tables, mainly, probabilistic characteristics, the results of which were obtained by the appropriate statistical processing of long series of observations, is given in generalized form by regions and as a function of averages. A short description is given of the general regularities of the region and conditions of the element contained in it, the knowledge of which is necessary for correct use of the material. The section on soil temperature is augmented by characteristics of temperature, frosts on the soil surface, and data on soil freezing and thawing. Author (TAB)

N69-36213# Pennsylvania State Univ., Dept. of Meteorology.
FOG CHARACTERISTICS AND MODIFICATION CONCEPTS
J. E. Jiusto, C. L. Hosler, L. G. Davis, and E. J. Mack Jun. 1968 58 p refs Supported in part by the Coal Res. Board of Pa.
(Grant NSF GA-777)
(Rept-12) Avail: Issuing Activity

An investigation of selected fog characteristics and control concepts, emphasizing the possible use of coal derivatives, was conducted. The results indicate that measurements of fog parameters, such as drop-size, liquid water content, condensation nucleus concentrations, and visibility, are in general agreement with structural fog models previously formulated. Occasionally, exceptionally high concentrations of condensation nuclei at low supersaturations (0.02%) were observed that appeared to be associated with effluent from upwind pulp mills. An analytical review of fog (cloud) seeding with carbon particles to enhance solar absorption and promote droplet evaporation reaffirmed the feasibility of conducting such field tests. Three attempts were made to dispense milled anthracite coal particles in the tops of fog and stratus. While very little success was obtained in dissipating clouds, the observations indicated that the coal particles may have altered the environment over small localized regions. Author

N69-36219# Massachusetts Inst. of Tech., Cambridge.
SIGNIFICANT ADVANCES IN STATISTICAL LONG-RANGE FORECASTING Final Scientific Report
Donald B. De Vorkin and John T. Prohaska 30 May 1969 75 p refs
(Grant ESSA-WB-E-41-68(G))
Avail: Issuing Activity

It is the purpose of this report to demonstrate that there exists meaningful predictability of monthly and seasonal U.S.

temperature anomalies at rather long range. Successful experiments along two separate approaches, one employing pressure predictors and the other using temperature predictors, lead to an accomplishment of this purpose. Monthly precipitation anomalies are shown to be statistically related to monthly temperature anomalies on a contemporary basis. In this way we are led to conclude that long range monthly and seasonal precipitation pattern prediction is a meaningful pursuit. The first chapter provides a preliminary discussion on mathematical tools. Chapter II displays empirical orthogonal function decompositions of pressure, temperature, and precipitation, and contains the statistical results on dependent sample lag relations of these fields. The last chapter presents the methods and results of independent sample temperature to temperature prediction. Author

N69-36222*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
GROUND WIND CHARACTERISTICS AT KENNEDY SPACE CENTER Final Report
G. E. Mc Vehil and H. G. Camnitz Washington NASA Sep. 1969 111 p refs
(NASA-CR-1418) Avail: CFSTI CSCL 04B

Wind data from a 150-meter tower at Kennedy Space Center have been analyzed to provide statistical information on mean wind speed, maximum wind speed, gust factor and surface friction velocity. The data have also been utilized for analysis of spectra of the lateral component and for study of gust intensity, duration and acceleration. Frequency distributions, derived from one year of hourly observations, are presented for mean wind speed, 10-minute and one-hour maximum wind speed, and gust factor for each of six observation heights. Annual statistics are also derived fro surface friction velocity μ_* and the exponent in a power-law representation of mean wind profiles. Conditional frequency distributions for each variable, computed for restricted classes of wind direction, wind speed, and stability, are interpreted in terms of the physical relationships between wind parameters. Author

N69-36275*# Techtran Corp., Glen Burnie, Md.
WEATHER THAT IS NOT VISIBLE FROM EARTH: HIGH-RESOLUTION TELEVISION PHOTOGRAPHY
N. F. Vel'Tishchev 1968 12 p Transl. into ENGLISH from (USSR) Presented at UN Conf. Exploration and Peaceful Uses of Outer Space, Vienna, 14–27 Aug. 1968
(Contract NAS5-14826)
(NASA-CR-105643) Avail: CFSTI CSCL 04B

A new, dynamic cloud classification based on the morphology of cloud cover as seen by television from space is considered, and the genesis of clouds which are seen from space and are not on synoptical maps is studied. Convective, orographic and other types of cloud systems as seen on satellite television are discussed. It is concluded that meteorologists will achieve a better understanding of thermal and dynamic conditions relating to cloud formation using space weather observations for effective use in forecasting. F.O.S.

N69-36283# Oklahoma Univ., Norman. Dept. of Meteorology.
INVESTIGATION OF WIND AND TEMPERATURE PROFILES IN THE PLANETARY BOUNDARY LAYER
H. M. Baddley, Jr. Sep. 1968 59 p refs
(Contract ESSA-E-22-108-68(G))
(ARL-1653-5) Avail: Issuing Activity

The atmosphere was divided into various layers. Principally, these were the surface boundary layer or constant flux layer, the Ekman layer or transition layer, and the free atmosphere. The surface layer and the Ekman layer were combined to form the planetary boundary layer. The surface boundary layer, extending from the surface to approximately 50 m but never more than 100 m, was the region where the shearing stresses were approximately constant and the wind distribution was determined largely by the vertical temperature gradient and the nature of the underlying surface. The Ekman layer was the region of varying shearing stress where the wind structure was influenced by surface friction, density gradient, and rotation of the earth. The upper boundary of the Ekman layer was the level where the wind velocity approaches geostrophic balance (balance between the horizontal pressure gradient force and the deflecting force caused by earth's rotation). Author

N69-36285# Weather Bureau, Silver Spring, Md. Techniques Development Lab.
A LAKE ERIE STORM SURGE FORECASTING TECHNIQUE
William S. Richardson and N. Arthur Pore Aug. 1969 28 p refs
(WBTM-TDL-24) Avail: CFSTI

Two methods for forecasting storm surge on Lake Erie at Buffalo, New York, and Toledo, Ohio, are presented. One method is for manual use at a Weather Bureau Forecast Office; the other is for use on a computer at a meteorological center where numerical weather forecasts are available as input. Both methods were derived by screening regression. Each method is tested with dependent and independent data. Hourly storm surge test forecasts 13 to 24 hours in advance for four storm surge cases at Buffalo and Toledo are forecast by the computer method with actual numerical forecasts of sea-level pressure as input. Author

N69-36301# Oklahoma Univ., Norman. Dept. of Meteorology.
COLD AIR PRODUCTION DUE TO THUNDERSTORMS
James A. Herman and Yoshikazu Sasaki Sep. 1968 55 p refs
(ARL-1653-4) Avail: CFSTI

Cold air production ratios were calculated for two separate mesoscale thunderstorm systems over Oklahoma and Texas on 25–26 March 1967. The mechanism proposed by Fujita was adequate for the excess pressure with the thunderstorm system on the afternoon of March 25. Temperatures near the 800 mb level decreased about 5C over the area of excess pressure with the thunderstorm system the night of March 25–26. The conclusion was that the cold air advection at 600 mb contributed to the excess pressure at the surface and possibly was the same order of magnitude as the cold air production from evaporation of rain in the sub-cloud layer. Five sets of calculations for a hypothetical case are presented to show the relation between the excess pressure and the cold air production ratios. Author

N69-36311# Oklahoma Univ., Norman. Dept. of Meteorology.
ON THE LOW-LEVEL INFLOW INTO THUNDERSTORMS, A CASE STUDY
J. P. Charba and Y. Sasaki Sep. 1968 17 p refs
(Grant ESSA-E-22-108-68(G))
(ARL-1653-3) Avail: Issuing Activity

The results of a feasibility study with efforts to define the three dimensional extent of the low and mid-level interaction of the severe storm and the environmental flow in which it is embedded are reported. Results from 16 April 1968 storm data indicate that an intense storm which moved from west–southwest to east–northeast along a path just north of Oklahoma City was characterized by a narrow, high speed inflow current which was detected over 40 nm upwind. Balloon transponder data suggest that the thunderstorm updraft was fed by this mesojet. The mesojet current approaching the storm underwent horizontal deceleration and upward vertical motion. Author

N69-36343# Oklahoma Univ., Norman. Dept. of Meteorology.
A STUDY OF NUMERICAL MOISTURE FORECAST
T. S. Chen Sep. 1968 22 p refs
(Grant ESSA-E-22-108-68(G))
(ARL-1653-7) Avail: Issuing Activity

A dynamical forecast model is applied to forecast the moisture variation in the planetary boundary layer. The observed 12-hour moisture patterns are compared with the forecasted patterns. Two case studies, using the same initial data on 0600 CST, March 25, 1967 are made. However, one case considers the topography of the region whereas the other case doesn't. The vertical spacing is 400 meters with one case measured from the ground surface while the other case, from the mean sea level. The results indicate that for both cases the forecasted moisture patterns agree adequately with the observed patterns except in the area of the Gulf of Mexico the forecasted value is 2 gm kg^{-1} too high. A substantial tilt of the moisture ridge line to the left as compared with the initial distribution is observed. Vertical velocities w for both cases are poorly forecasted. Research directed toward a better moisture forecast is discussed. Author

N69-36346# National Severe Storms Lab., Norman, Okla.
STRUCTURE AND MOVEMENT OF THE SEVERE THUNDERSTORMS OF 3 APRIL 1964 AS REVEALED FROM RADAR AND SURFACE MESONETWORK DATA ANALYSIS
Jess Charba (Okla. Univ., Norman) and Yoshikazu Sasaki (Okla. Univ., Norman) Oct. 1968 52 p refs
(ERLTM-NSSL-41) Avail: CFSTI

Detailed analyses of radar echoes, NSSL Beta-network data and upper air soundings recorded on 3 April 1964 are made to investigate possible mechanisms of the movement of severe thunderstorms. From the analyses, it is apparent that the direction and speed of storm movement correlate directly with low-level inflow as described and characterized by the surface patterns of wind, pressure, temperature, and humidity, and also with storm rotation as indicated by the motion of small storm echo elements. Storm speed and direction to the right or left of the mean tropospheric wind can be explained as a result of combined effects of storm rotation, drag and propagation. Importance of the propagation process on the storm movement is demonstrated in the results of these analyses. Author

N69-36348# Oklahoma Univ., Norman. Dept. of Meteorology.
EVAPORATION AND MOISTURE TRANSPORT FROM THE GULF OF MEXICO
James E. Harris Sep. 1968 45 p refs
(Grant ESSA-E-22-108-68(G))
(ARL-1653-1) Avail: Issuing Activity

Quantitative estimates of evaporation and vertical moisture transport from the Gulf of Mexico were determined for the case of 25 March 1967. Areas of cloud cover, as seen in satellite photographs, were compared with the evaporation and vertical moisture transport distributions. Close agreement was obtained. Author

N69-36383*# Environmental Science Services Administration, Silver Spring, Md. Space Operations Support Div.
PROBABILITY OF TROPICAL CYCLONE INDUCED WINDS AT NASA MANNED SPACECRAFT CENTER
Charles J. Neumann May 1969 50 p refs Sponsored by NASA
(NASA-CR-105558; WBTM-SOS-4) Avail: CFSTI CSCL 04B

A statistical analysis of tropical cyclones as they affected the area midway between Houston and Galveston, Texas during the period of record from 1886 to 1967 is presented. The Poisson distribution is used to estimate the probability of the center observing occurrences of sustained 35-knot winds over consecutive years. The bivariate normal distribution is used to estimate the probability of an existing tropical storm or hurricane producing sustained 35-knot winds at 24-hourly intervals and within 24-hourly intervals for prognostic periods of up to four or five days depending on the source region of the storm. Presented also are charts and figures depicting the Gulf of Mexico tropical climatology. Author

N69-36401# Joint Publications Research Service, Washington, D.C.
SATELLITE METEOROLOGY
22 Jul. 1969 81 p refs Transl. into ENGLISH from Sputnikovaya Meteorol. (Leningrad), no. 11, 1966 p 15–33, 96–104, 115–137, 145–159
(JPRS-48461) Avail: CFSTI

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2. ORIENTATION OF CLOUD BANKS RELATIVE TO AIR FLOW OBSERVED FROM SATELLITES I. A. Alekseyeva et al p 15–23 refs (See N69-36403 21-20)

3. MACHINE CONSTRUCTION OF TEMPERATURE MAPS OF THE EARTH'S SURFACE AND THE ALTITUDE OF THE UPPER CLOUD BOUNDARY ACCORDING TO DATA FROM METEOROLOGICAL SATELLITES V. G. Boldyrev p 24–35 refs (See N69-36404 21-20)

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6. CALCULATION AND ANALYSIS OF RADIATION FLUXES AND HEAT FLUXES IN THE PRESENCE OF CLOUDS N. V. Voytko et al p 64–72 refs (See N69-36407 21-20)

7. INFRARED INFORMATION ABOUT CLOUDS FROM SATELLITES Ye. P. Dombkovskaya p 73–82 refs (See N69-36408 21-20)

N69-36402# Joint Publications Research Service, Washington, D.C.
REPRODUCTION OF THE WIND FIELD IN A CYCLONE USING TELEVISION PICTURES OF CLOUD COVER FROM SATELLITES
N. F. Veltishchev et al *In its* Satellite Meteorology 22 Jul. 1969 p 1–14 refs (See N69-36401 21-20)
Avail: CFSTI

This article contains a discussion of a technique for reproducing the wind current field in a cyclone using television pictures of the cloud cover from satellites. The calculations by the proposed procedure are performed on a computer. Comparison of the results of the calculation with actual wind data permits the hope that the proposed scheme for reproducing the wind current field can be useful in regions with a sparse network of weather stations. Author

N69-36403# Joint Publications Research Service, Washington, D.C.
ORIENTATION OF CLOUD BANKS RELATIVE TO AIR FLOW OBSERVED FROM SATELLITES
I. A. Alekseyeva et al *In its* Satellite Meteorology 22 Jul. 1969 p 15–23 refs (See N69-36401 21-20)
Avail: CFSTI

The effect of the vertical wind and temperature distribution on the mutual orientation of cloud banks and air flow isinvestigated. It is demonstrated that with temperature stratification close to

adiabatic and a jet wind profile, the cloud banks have a tendency to be oriented along the flow if the wind direction varies insignificantly with altitude. Author

N69-38404# Joint Publications Research Service, Washington, D.C.
MACHINE CONSTRUCTION OF TEMPERATURE MAPS OF THE EARTH'S SURFACE AND THE ALTITUDE OF THE UPPER CLOUD BOUNDARY ACCORDING TO DATA FROM METEOROLOGICAL SATELLITES
V. G. Boldyrev *In its* Satellite Meteorology 22 Jul. 1969 p 24–35 refs (See N69-36401 21-20)
Avail: CFSTI

This article contains a description of an operative scheme for computer calculation of the altitude of the upper boundary of clouds and the temperature of the earth's surface using data from measurements of outgoing radiation from satellites. Author

N69-38405# Joint Publications Research Service, Washington, D.C.
CALCULATION AND ANALYSIS OF LONG-WAVE RADIATION IN THE ATMOSPHERE
V. G. Boldyrev et al *In its* Satellite Meteorology 22 Jul. 1969 p 36–51 refs (See N69-36401 21-20)
Avail: CFSTI

Some results of calculating the magnitudes of the outgoing radiation in various spectral intervals and radiation heat fluxes at various levels of the atmosphere for the territory of the Northern Hemisphere are discussed with respect to average climatic data on the state of the atmosphere. Author

N69-38406# Joint Publications Research Service, Washington, D.C.
STRUCTURAL PECULIARITIES OF LONG-WAVE RADIATION FLUXES
Yu. B. Kurilova *In its* Satellite Meteorology 22 Jul. 1969 p 52–63 refs (See N69-36401 21-20)
Avail: CFSTI

The structure of the vertical flux distribution of long wave radiation is investigated statistically by experimental observations using actinometric radiosondes. Results are presented from calculating the correlation matrices and structural functions for effective long wave radiation flux and for ascending and descending fluxes. The role of various clouds perturbing the long wave radiation field is demonstrated. Author

N69-38407# Joint Publications Research Service, Washington, D.C.
CALCULATION AND ANALYSIS OF RADIATION FLUXES AND HEAT FLUXES IN THE PRESENCE OF CLOUDS
N. V. Voytko et al *In its* Satellite Meteorology 22 Jul. 1969 p 64–72 refs (See N69-36401 21-20)
Avail: CFSTI

The procedure is discussed and the results presented from calculating radiation fluxes and heat fluxes in the presence of a cloud layer in the atmosphere. Author

N69-38408# Joint Publications Research Service, Washington, D.C.
INFRARED INFORMATION ABOUT CLOUDS FROM SATELLITES
Ye. P. Dombkovskaya *In its* Satellite Meteorology 22 Jul. 1969 p 73–82 refs (See N69-36401 21-20)
Avail: CFSTI

This article contains a discussion of the possibility of obtaining information about clouds from the shadow side of the earth by means of infrared equipment. A brief description of the results of using radiation maps compiled by the infrared data in synoptic practice is presented. There is also a description of photographing the earth's surface and clouds in the infrared spectral region. Author

N69-38504 World Meteorological Organization, Geneva (Switzerland).
SYSTEM FOR THE COLLECTION OF SHIPS' WEATHER REPORTS
M. Hanzawa and T. H. Tournier 1968 90 p Partly in ENGLISH and partly in FRENCH! *Its* World Weather Watch Planning Rept. No. 25
Copyright. Avail: Issuing Activity

The fifth World Meteorological Congress decided that planning studies on the various components of the Global Observing and Telecommunication Systems should be continued and one important aspect of this question is the collection and dissemination of mobile ships' weather reports. An analysis of the efficiency of the present ships' weather reporting system was made, based on inquiries organized in such a way that the main stages in the process of ships' weather message transmissions could be analyzed, i.e. transmission from ships to coastal stations, reception at coastal stations, and reception at national meteorological centers. This also permitted an examination of the geographical distribution of the weather observations obtained over the seas and an evaluation of the present system for the dissemination of the ships' weather reports. The present system has the following basic deficiencies: 1) a voluntary observational network cannot provide the same efficiency and regularity as a network where the observations are made by meteorological personnel engaged for this purpose and having professional training, and 2) it is not possible to cover adequately the surface of the world's oceans with observations made aboard merchant ships, since the traffic lines are not equally distributed over the oceans. The possibility of applying new techniques which are progressing very rapidly and which might in the future replace the conventional methods of weather observations in use at present over the sea are also discussed. Author (ESRO)

N69-38505 World Meteorological Organization, Geneva (Switzerland).
DETERMINATION OF THE ECONOMIC VALUE OF A NATIONAL METEOROLOGICAL SERVICE DETERMINATION DE LA VALEUR ECONOMIQUE D'UN SERVICE METEOROLOGIQUE NATIONAL)
1967 25 p refs In FRENCH; ENGLISH summary *Its* World Weather Watch Planning Rept. No. 17
Copyright. Avail: Issuing Activity

The scientific and technological advances which have provided the impetus for the establishment of the World Weather Watch program will unquestionably also have an impact on the future activities of all national meteorological services. The resulting improvements are expected to entail an over-all increase in resources for the provision of meteorological services, and there is therefore an increasing need to assess the economic, social and other benefits of improving weather services. The present report is a preliminary attempt to provide some guidance on possible methods of attacking the problem. It begins with a general description of meteorological information and climatological advice for recurring operational decisions and long-range planning. The next section discusses the data required for conducting cost/benefit analyses and is followed by a section dealing with the analyses of the data, with special reference to the advantages of expressing the results as a cost/benefit ratio. The need is stressed for ensuring that

meteorological advice reaches all the potential users and that the advice is efficiently used. Some examples of economic studies of weather services are given in the appendix to the report.
Author (ESRO)

N69-36506 World Meteorological Organization, Geneva (Switzerland)
COLLECTION, STORAGE AND RETRIEVAL OF METEOROLOGICAL DATA
1969 49 p refs *Its* World Weather Watch Planning Rept. No. 28
Copyright. Avail: Issuing Activity

The first part of this report reviews the problems to be solved in the collection, storage and retrieval of meteorological data and shows that all primary data should be archived in digital form on a standard technical carrier in at least one center, and that the data should first have undergone computerized quality control. The types of data to be stored at the world, regional and national meteorological centers are listed and efforts should be maintained to convert data already held in national archives in analog and manuscript form into digital form on suitable technical media. The methods to be used for collecting data are considered and it shows that the best use of the global telecommunication channels requires better control procedures and improved codes. Another section is devoted to the problem of quality control, with special reference to real-time checking by computer. The necessity of a definite classification system and a standard catalogue for the retrieval of archived data is stressed. Specific proposals are presented regarding the essential features of a world-wide system for the collection, storage and retrieval of data for meteorological research and other purposes. It is suggested that this system be introduced in two stages, the 'interim system' to be implemented immediately and to be in full operation by 1971, and the 'ultimate system' which represents the long-term goal.
Author (ESRO)

N69-36507 World Meteorological Organization, Geneva (Switzerland).
STANDARDS AND PROCEDURES FOR THE PRESENTATION OF PROCESSED DATA IN DIGITAL FORM
J. R. Neilon and E. Terauchi 1969 49 p refs *Its* World Weather Watch Planning Rept. No. 29
Copyright. Avail: Issuing Activity

The ever-growing use of electronic computers for solving meteorological problems in the field of numerical weather prediction is generating large amounts of processed data in digital form. Requirements for this type of data are increasing; this report describes some present as well as future needs for processed data in digital form. Several possible methods of presentation of the digital form of processed data are explored. The conclusion is drawn that for many requirements a geographical grid is the most appropriate form. A recommendation is made for the basic framework of a grid system suitable for international data exchange. The format of presentation is considered, and a recommended form given. Although a geographical grid system is recommended as the standard to be used when feasible, provision is also made for the user of Cartesian grids which are widely employed in numerical weather prediction centers. The telecommunication aspects of the use of digital data are also briefly considered.
Author (ESRO)

N69-36508 World Meteorological Organization, Geneva (Switzerland)
INSTRUMENT DEVELOPMENT INQUIRY
1968 253 p refs
(WMO-232.TP.125) Copyright. Avail: Issuing Activity

A number of replies to questionnaires are reproduced containing information concerning meteorological instruments and operating experience. Among the instruments listed are devices to measure aerosols, albedo, atmospheric electricity, atmospheric pressure and temperature, carbon dioxide and ozone content, cloud parameters, dew point, evaporation and evapotranspiration, ice formation, precipitation, altitude, electromagnetic radiation, wind variations, and airborne, radar, and automatic weather station equipment.
ESRO

N69-36521 World Meteorological Organization, Geneva (Switzerland).
THE WORLD WEATHER WATCH AND METEOROLOGICAL SERVICE TO AGRICULTURE
L. P. Smith 1967 23 p *Its* World Weather Watch Planning Rept. No. 22
Copyright. Avail: Issuing Activity

The aim of agricultural meteorology is to interpret environmental factors in terms of their effects on biological and agricultural processes. To do this, it has to carry out basic research to examine the fundamental processes of photosynthesis and growth. It also has to initiate field research to establish interim links between the two sets of observed facts which can be put to practical operational use. Such work leads to a functional service by meteorology for agriculture and helps in the solution of problems of agricultural prediction involving the incidence of pests and diseases and the estimation of crop yields. The organization of this combination of research, investigation and service needs accurate meteorological data. Many of these data are of the type already incorporated in the WWW (World Weather Watch) plan, but some, such as relative humidity, are needed to a higher degree of precision. Furthermore, denser networks of observations are often required. Special processing systems are needed for the purposes of agricultural prediction. The degree to which data can be centralized, either for storage or processing, is somewhat restricted by the need for information on a mesoscale and also by the absence of uniformity in the treatment of the data due to changes in the type of operational problem from area to area. The usefulness of weather forecasts is limited by the restricted choice of action available to a farming enterprise. For this reason weather forecasts for agriculture must be functional in character and presented in a manner which is related directly to the current local farming problem. Any centrally issued forecast therefore needs local interpretation and presentation. If research permits the future issue of seasonal or climate trend forecasts, these would be of considerable economic importance to short- and long-range agricultural planning.
Author (ESRO)

N69-36522 World Meteorological Organization, Geneva (Switzerland).
WEFAX: A WEATHER DATA COMMUNICATIONS EXPERIMENT
1968 32 p *Its* World Weather Watch Planning Rept. No. 23
Copyright. Avail: Issuing Activity

WEFAX (WEather FAcsimile eXperiment) is an experiment to explore the operational feasibility of direct transmission of meteorological data from a central source to widely scattered remote weather stations. The transmission medium used for the experiment is the VHF communication facilities of ATS-1 (Applications Technology Satellite). The receiving stations co-operating in the experiment are located over an area extending from the east coast of the United States to Australia and Japan. Processed meteorological data applicable to the area of communications coverage of the satellite are being transmitted to the participating ground stations. These include prepared weather map analyses and prognoses, as well as ESSA 3 and 5 and ATS-1 spin-can cloud-camera pictures processed by computer into APT formats. These data are transmitted directly to the ATS ground station, using a facsimile quality land-line where they are sent to

the spacecraft by the up-link transmitter. The VHF transponder aboard the spacecraft retransmits the data for reception at stations with APT equipment which have been modified to receive the ATS-1 frequency of 135.6 MHz. The APT stations participating in the experiment on a voluntary basis evaluate the effectiveness of the WEFAX experiment. It has been proposed that WEFAX be included in the ATS-3 program. An associated system is being used experimentally to collect river and rainfall readings from hydrological gaging stations. These stations report when interrogated by a command sent through the ATS-1 satellite. The responses from the stations through the satellite are received at Washington and recorded on a teleprinter. Preliminary indications are that satellites can be used successfully to relay hydrological data from relatively unattended remote sites to existing APT stations. Author (ESRO)

N69-36523 World Meteorological Organization, Geneva (Switzerland).
THE POTENTIAL CONTRIBUTION OF THE WORLD WEATHER WATCH TO A GLOBAL AREA FORECAST SYSTEM FOR AVIATION PURPOSES
1967 46 p *Its* World Weather Watch Planning Rept. No. 19
Copyright. Avail: Issuing Activity

The problems involved in the creation of an interim area forecast system are discussed. It is expected that technological progress will fundamentally affect the forecast system and the increased length of meteorological flights creates problems of computer flight planning and agreement on grid systems. A map scale of $1:20 \cdot 10^6$ presents several advantages, but a scale of $1:15 \cdot 10^6$ is likely to be more widely adopted. Data processing, chart dissemination and forecasting for air routes are also discussed. Author (ESRO)

N69-36527 World Meteorological Organization, Geneva (Switzerland).
METEOROLOGICAL PROBLEMS IN THE DESIGN AND OPERATION OF SUPERSONIC AIRCRAFT
R. F. Jones, R. M. McInturff, and S. Teweles 1967 77 p refs (WMO-216-TP-114; TN-89) Copyright. Avail: Issuing Activity

New meteorological problems must be investigated in connection with the introduction of supersonic commercial aircraft, relating to the take-off, initial climb, transonic, cruise, deceleration and landing phases. The influence of ambient temperature on jet engine performance, particularly during the transonic phase, is discussed. The dependence of the ground sonic boom intensity on meteorological parameters is described and turbulence problems connected with cumulo-nimbus activity, mountains, and jet streams are stressed. Ozone and cosmic radiation constitute a hazard to crews, which must be forecast and hydrometeors and lithometeors may cause impact damage to aircraft. ESRO

N69-36530 World Meteorological Organization, Geneva (Switzerland).
GLOBAL DATA PROCESSING SYSTEM: QUALITY CONTROL PROCEDURES FOR METEOROLOGICAL DATA
V. V. Filippov 1968 63 p refs *Its* World Weather Watch Planning Rept. No. 26
Copyright. Avail: Issuing Activity

This report is devoted to various aspects of the quality control of meteorological information and discusses the reliability of meteorological observations, the causes of observation errors and methods of preventing such errors. A section is devoted to the quality control of meteorological information during transmission and the use of error-detecting codes is proposed as a basic method for increasing reliability of the telecommunication system. Another section deals with the various aspects of the control of meteorological information to be stored permanently on technical media and the last part gives a synoptic survey of methods for the quality control of meteorological information, mainly in respect of upper-air observations, for the purpose of numerical analysis and forecasting. Author (ESRO)

N69-36532 World Meteorological Organization, Geneva (Switzerland).
SPEED-UP OF FACSIMILE TRANSMISSION: VESTIGIAL SIDEBAND TRANSMISSION SYSTEM
1967 71 p *Its* World Weather Watch Planning Rept. No. 20
Copyright. Avail: Issuing Activity

Experiments on the improvement of facsimile transmission of meteorological charts by using vestigial sideband transmission are described. A Japanese discussion of the homodyne detection type of VSB (Vestigial Sideband) is amply documented by oscillograms and there are short reports on tests carried out in Great Britain and the Federal Republic of Germany. Author (ESRO)

N69-36537# Environmental Technical Applications Center (Air Force), Washington, D.C.
AN ANNOTATED CLIMATOLOGICAL BIBLIOGRAPHY OF RUMANIA
Vincent J. Cressi May 1969 33 p refs
(AD-688259; ETAC-TN-69-3) Avail: CFSTI CSCL 4/2

The bibliography contains 61 separate sources on climatological data and textual references for Romania. All items are furnished with a brief abstract. A subject index of the items is included. All items indicate the source library where the reference is filed. Author (TAB)

N69-36569 World Meteorological Organization, Geneva (Switzerland).
THE ECONOMIC BENEFITS OF NATIONAL METEOROLOGICAL SERVICES
1968 63 p refs Presented at the 20th Session of WMO Executive Comm., Geneva *Its* World Weather Watch Planning Rept. No. 27
Copyright. Avail: Issuing Activity

CONTENTS:

1. BENEFITS OF METEOROLOGICAL SERVICES IN AUSTRALIA W. J. Gibbs p 1–7 refs (See N69-36560 21-20)

2. THE ECONOMIC ADVANTAGES OF THE FRENCH NATIONAL METEOROLOGICAL SERVICE T. L. Giovannelli p 9–17 refs (See N69-36561 21-20)

3. THE ECONOMIC VALUE OF METEOROLOGICAL SERVICES IN THE UNITED KINGDOM B. J. Mason p 19–24 (See N69-36562 21-20)

4. THE BENEFITS OF METEOROLOGICAL SERVICES IN THE USSR E. I. Tolstikov p 25–29 (See N69-36563 21-20)

5. WEATHER AND THE CONSTRUCTION INDUSTRY R. M. White p 31–35 (See N69-36564 21-20)

6. THE APPLICABILITY OF COST/BENEFIT ANALYSIS IN ASSESSING THE VALUE OF METEOROLOGICAL SERVICES N. Scott p 37–40 (See N69-36565 21-20)

7. POTENTIAL ECONOMIC BENEFITS FROM IMPROVEMENTS IN WEATHER INFORMATION J. C. Thompson p 41–49 (See N69-36566 21-20)

8. ECONOMIC BENEFITS OF THE METEOROLOGICAL SERVICE OF THE FEDERAL REPUBLIC OF GERMANY: A PRELIMINARY STUDY E. Süssenberger p 51–63 (See N69-36567 21-20)

N69-36560 World Meteorological Organization, Geneva (Switzerland).
BENEFITS OF METEOROLOGICAL SERVICES IN AUSTRALIA
J. Gibbs *In its* Econ. Benefits of Natl. Meteorol. Serv. 1968 p 1–7 refs (See N69-36559 21-20)
Copyright. Avail: Issuing Activity

Starting by pointing out the great demand for meteorological information from members of the public for diverse purposes, the report then examines the use made by agriculture and industries, and includes the part played by the meteorological service in disastrous events such as droughts, flooding, cyclones and bushfires, particular stress being placed on the latter. The report concludes by showing that in the year 1966–67 the estimated value of benefits exceeded the budget of the Australian Bureau of Meteorology by over twenty-seven times. Author (ESRO)

N69-36561 World Meteorological Organization, Geneva (Switzerland).
THE ECONOMIC ADVANTAGES OF THE FRENCH NATIONAL METEOROLOGICAL SERVICE
J. L. Giovannelli *In its* Econ. Benefits of Natl. Meteorol. Serv. 1968 p 9–17 refs (See N69-36659 21-20)
Copyright. Avail: Issuing Activity

In considering the clients of the meteorological services, it is noted that of public services by telephone, weather forecasts are the most utilized. In reviewing the benefits gained by agriculture, the service to which must still be much improved, it is shown how meteorological advice could save a vast amount of expense in vineyards. The transport and power industries are reviewed, and also the cyclone warning system in overseas French territories. The estimated annual benefit to the community amounts to at least twenty times the annual budget of the French meteorological service. Author (ESRO)

N69-36562 World Meteorological Organization, Geneva (Switzerland).
THE ECONOMIC VALUE OF METEOROLOGICAL SERVICES IN THE UNITED KINGDOM
B. J. Mason *In its* Econ. Benefits of Natl. Meteorol. Serv. 1968 p 19–24 (See N69-36559 21-20)
Copyright. Avail: Issuing Activity

After a short introduction, the economic benefits derived by specific fields of the national economy are examined and a benefit/cost ratio of at least 100:1 is suggested in the case of agriculture, the gas industry and certain aspects of civil engineering. The potential value of improved forecasts is considered, and the fact noted that present meteorological knowledge is not being fully utilized. In conclusion, the over-all benefits are estimated to exceed the annual meteorological office budget by at least twenty times. Author (ESRO)

N69-36563 World Meteorological Organization, Geneva (Switzerland).
THE BENEFITS OF METEOROLOGICAL SERVICES IN THE USSR
E. I. Tolstikov *In its* Econ. Benefits of Natl. Meteorol. Serv. 1968 p 25–29 (See N69-36559 21-20)
Copyright. Avail: Issuing Activity

The successful application of meteorology to many sectors of the national economy is described; examples are given relating to ice formation on power lines and a district heating plan in Moscow. Weather routing of ships and protection of crops from hail are also dealt with. Possible economic benefits of the hydrometeorological services are assessed at four to five times the amount of the annual budget. Author (ESRO)

N69-36564 World Meteorological Organization, Geneva (Switzerland).
WEATHER AND THE CONSTRUCTION INDUSTRY
R. M. White *In its* Econ. Benefits of Natl. Meteorol. Serv. 1967 p 31–35 (See N69-36559 21-20)
Copyright. Avail: Issuing Activity

The method used for finding where the weather services could best be utilized is described. The construction industry was found to offer, after agriculture, the best economic benefit potential in the United States. The methods used to find out how meteorological information could best help the construction industry to cut its annual weather loss of $3,000 million are described. Finally, it is suggested that WMO should encourage individual Members to conduct detailed studies into ways their Meteorological Services could help specific industries. Author (ESRO)

N69-36565 World Meteorological Organization, Geneva (Switzerland).
THE APPLICABILITY OF COST/BENEFIT ANALYSIS IN ASSESSING THE VALUE OF METEOROLOGICAL SERVICES
Norman Scott *In its* Econ. Benefits of Natl. Meteorol. Serv. 1968 p 37–40 (See N69-36559 21-20)
Copyright. Avail: Issuing Activity

As there is an increasing demand for financial support from governments by many sectors of the economy, a cost/benefit analysis should help economists to determine which projects offer the greatest benefits. This is especially applicable in the case of 'collective goods' for which there is no market indication of how much the consumer is willing to pay. The various steps in such a study are outlined. An appendix lays out four methods of arriving at a choice between different projects. Author (ESRO)

N69-36566 World Meteorological Organization, Geneva (Switzerland).
POTENTIAL ECONOMIC BENEFITS FROM IMPROVEMENTS IN WEATHER INFORMATION
J. C. Thompson *In its* Econ. Benefits of Natl. Meteorol. Serv. 1968 p 41–43 (See N69-36559 21-20)
Copyright. Avail: Issuing Activity

It is suggested that the degree of probability of a certain weather occurrence can be useful to a client particularly interested in that event, so that he can weigh it against the operational risk. Using these as the basis of a 'model', an assessment can be made of the economic improvements obtainable with (a) optimum use of currently available weather information, and (b) further advances in scientific knowledge. Applying the 'model' to actual forecasts made for certain locations, it is shown that weather losses could be cut by 2 per cent to 6 per cent in case (a) and by an additional 5 per cent to 6 per cent if 'perfect' forecasts could be achieved. Author (ESRO)

N69-36567 World Meteorological Organization, Geneva (Switzerland).
ECONOMIC BENEFITS OF THE METEOROLOGICAL SERVICE OF THE FEDERAL REPUBLIC OF GERMANY: A PRELIMINARY STUDY
E. Süssenberger *In its* Econ. Benefits of Natl. Meteorol. Serv. 1968 p 51–53 (See N69-36559 21-20)
Copyright. Avail: Issuing Activity

Examples are given of benefits derived from the general forecast service, the Climatic Advisory Service and the Agricultural Meteorological Advisory Service. In each case, statistics of the value of the benefits are given; the report concludes by recalling that the annual saving to the construction industry alone amounts to approximately four times the annual budget of the Deutscher Wetterdienst. Author (ESRO)

N69-36583 World Meteorological Organization, Geneva (Switzerland).

DATA PROCESSING FOR CLIMATOLOGICAL PURPOSES

1969 144 p refs Proc. of the WMO Symp., Asheville, N.C., 1968 Partly in ENGLISH and partly in FRENCH
(WMO-242-TP-132; TN-100) Copyright. Avail: Issuing Activity

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1. PROBLEMS OF DATA PROCESSING CENTRE ESTABLISHMENT FOR THE CARIBBEAN METEOROLOGICAL INSTITUTE David Smedley (Caribbean Meteorol. Inst.) p 1–10 (See N69-36584 21-20)

2. COLLECTION THROUGH THE TELECOMMUNICATIONS SYSTEM AND CENTRAL PROCESSING OF CLIMATOLOGICAL DATA E. J. Sumner (Brit. Meteorol. Office) p 11–25 (See N69-36585 21-20)

3. AUTOMATED DATA PROCESSING AT THE UNITED STATES AIR FORCE ENVIRONMENTAL TECHNICAL APPLICATIONS CENTER John R. Collins, Jr. (USAF Environ. Tech. Appl. Center) p 26–30 (See N69-36586 21-20)

4. MICRO-MINI MEDIA Gilbert E. Stegall (Natl. Weather Records Center) p 31–38 (See N69-36587 21-14)

5. MANUAL EVALUATION OF AUTOGRAPHIC RECORDS FOR COMPUTER PROCESSING Uri Mané (Israel Meteorol. Ser.) p 39–45 (See N69-36588 21-20)

6. SEMI-AUTOMATIC READER FOR SCANNING OF CONVENTIONAL CLIMATOLOGICAL DIAGRAMS F. Bultot (Inst. Royal Météorol. de Belgique) and G. L. Dupriez (Inst. Royal Météorol. de Belgique) p 46–48 (See N69-36589 21-20)

7. STATISTICAL METHODS FOR AUTOMATIC CHECK OF METEOROLOGICAL INFORMATION L. S. Gandin (USSR Hydrometeorol. Serv.) p 49–51

8. THE FUTURE OF METEOROLOGICAL DATA ANALYSIS C. L. Godske (Bergen Univ.) p 52–63 Univ.) p 52–63 (See N69-36590 21-20)

9. AUTOMATIC DATA HANDLING AND PROCESSING FOR CLIMATOLOGICAL PURPOSES Harold L. Crutcher (Natl. Weather Records Center) p 64–91 refs (See N69-36591 21-20)

10. DAILY NORMALS FROM MONTHLY NORMALS H. C. S. Thom (Environ. Sci. Serv. Admin.) p 92

11. ON THE CLIMATOLOGICAL ANALYSIS OF LOCAL SERIES OF OBSERVATIONS R. Sneyers (Inst. Roy. Météorol. de Belgique) p 93–102 refs (See N69-36592 21-20)

12. PROCESSING UPPER ATMOSPHERIC ENVIRONMENTAL DATA FOR CLIMATOLOGICAL USE Lloyd V. Mitchell (USAF Environ. Tech. Appl. Center) p 103–125 refs (See N69-36593 21-20)

13. ON DATA PROCESSING MECHANIZATION FOR HYDROMETEOROLOGICAL REGIME STUDY N. K. Kijukin (Hydrometeorol. Serv. of USSR) p 126–132 (See N69-36594 21-20)

N69-36584 Caribbean Meteorological Inst., Bridgetown (Barbados).

PROBLEMS OF DATA PROCESSING CENTRE ESTABLISHMENT FOR THE CARIBBEAN METEOROLOGICAL INSTITUTE

David Smedley *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 1–10 (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

The experience gained in establishing a data processing system for meteorological observations on limited funds in the Caribbean Area is described. The system is based on mechanical equipment for processing punched cards and comprises a printer, sorter, card punch, collator, reproducer, and a desk calculator. Data transmission will be effected partly at least by telecommunication links. Other problems, such as staffing and staff training, publication formats, summarization and research requirements, are also discussed. ESRO

N69-36585 Meteorological Office (Gt. Brit.).

COLLECTION THROUGH THE TELECOMMUNICATIONS SYSTEM AND CENTRAL PROCESSING OF CLIMATOLOGICAL DATA

E. J. Sumner *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 11–25 (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

The paper describes the outcome of a series of trial experiments carried out within the British Meteorological Office in recent years, to collect surface climatological data for the British Isles from hourly reporting stations via the telecommunications network. This extra precision (e.g., temperatures to the nearest 0.1 °C) and elements (e.g., sunshine, hourly rainfall, hourly run of the wind, etc.) required by the climatologist and not normally contained in synoptic messages were provided through specially coded additions (hourly and daily) to the standard collectives. These data on (5-hole) teleprinter tape were read into the central computer for limited processing and were analyzed in other ways to obtain error statistics. The calculation of purely synoptic data for library retention on magnetic tape is a simpler derivative of the full scheme and plans are going ahead in the British Meteorological Office to extract a hemispheric coverage of foreign data (surface and upper-air) for several hundred stations from incoming teleprinter tapes, later this year. Author (ESRO)

N69-36586 Environmental Technical Applications Center (Air Force), Washington, D. C.

AUTOMATED DATA PROCESSING AT THE UNITED STATES AIR FORCE ENVIRONMENTAL TECHNICAL APPLICATIONS CENTER

John R. Collins, Jr. *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 26–30 (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

ETAC has established successful procedures for the creation of synoptic ordered climatological data files through the computer processing of global meteorological teleprinter traffic, with such files available since the fall in 1964. In addition, the processing system provides station-ordered files which are available as raw input data for the creation of station climatological files. Author (ESRO)

N69-36588 Israel Meteorological Service, Bet Dagen.

MANUAL EVALUATION OF AUTOGRAPHIC RECORDS FOR COMPUTER PROCESSING

Uri Mane *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 39–45 (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

The activities of two WMO Working Groups concerning climatological data aspects and the processing and exchange of meteorological data for research are described. Working material from various nations was used in this study, which was aimed at providing methods of attaining accuracy in meteorological data by various quality control procedures and offering suggestions for an integrated system for the World Weather Watch. Quality control should be applied at the observation points, and also during transmission, data processing and data storage. ESRO

N69-36589 Institut Royal Météorologique de Belgique, Brussels.

SEMI-AUTOMATIC READER FOR SCANNING OF CONVENTIONAL CLIMATOLOGICAL DIAGRAMS [LECTRICE SEMI-AUTOMATIQUE POUR DEPOUILLEMENT DES DIAGRAMMES CLIMATOLOGIQUES CONVENTIONNELS]

F. Buttot and G. L. Dupriez *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 46–48 In FRENCH (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

A semi-automatic reader used by the Institut Royal Météorologique de Belgique to scan various diagrams recorded by meteorological instruments (thermohygrographs, psychrographs, thermographs and pluviographs) is described. Data are directly transcribed to paper tape after manual determination of individual points of a curve. A certain number of error controls have been provided by which, incidentally, errors of the recording instruments were also detected.
ESRO

N69-36590 Bergen Univ. (Norway). Geophysical Inst.
THE FUTURE OF METEOROLOGICAL DATA ANALYSIS
C. L. Godske *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 52–63 (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

The processing of meteorological data on a worldwide basis is discussed. In error analysis, the level of reliability must be related to the level of importance and to a logical probability of parameter variations. For the presentation of observations, a model of multidimensional distributions of atmospheric variables is suggested permitting, after a synthesis of zero order, the selection of a model, and the estimation of population parameters. Further along in the synthesis the problem of significant correlation becomes important.
ESRO

N69-36591 National Weather Records Center, Asheville, N.C.
AUTOMATIC DATA HANDLING AND PROCESSING FOR CLIMATOLOGICAL PURPOSES
Harold L. Crutcher *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 64–91 refs (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

Starting from some general concepts of information theory, the problems of automation of parameter recording, data transmission, data processing, and data storage of climatological data are discussed.
ESRO

N69-36592 Institut Royal Météorologique de Belgique, Brussels.
ON THE CLIMATOLOGICAL ANALYSIS OF LOCAL SERIES OF OBSERVATIONS
R. Sneyers *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 93–102 refs (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

Differences between the observation periods of central stations and local ones with only several decades of data present difficulties for the study of climate on a regional scale due to the problem of assigning probabilities to observed values. Two kinds of improvements are discussed, the first one being provided by a good correlation between local and central observations, the second one by the existence of a regular variation of climatological components within the region.
ESRO

N69-36593 Environmental Technical Applications Center (Air Force), Washington, D. C.
PROCESSING UPPER ATMOSPHERIC ENVIRONMENTAL DATA FOR CLIMATOLOGICAL USE
Lloyd V. Mitchell *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 103–126 refs (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

There are at least 25 stations which contribute data to the US MRN and 15 of these make up the USAF ERSS. Original rocketsonde records are forwarded to USAF ETAC where they are checked manually. Altitude, time, wind, and temperature data are punched on cards for input into an IBM 7044. Fall velocities, wind components, pressures, densities, and speeds of sound are computed and questionable data indicated. An IBM computer program is used to drop soundings which need correcting and to copy those which are correct on another tape. Another IBM 1401 computer program, soon to be replaced by a 7044 computer program, is used to write the raob data onto magnetic tape. A 7044 computer program arranges the rocket soundings in chronological order by station and another 7044 program formats the data for publication in the World Data Center A Data Report, Meteorological Network Firings.
Author (ESRO)

N69-36594 Hydrometeorological Service of the USSR.
ON DATA PROCESSING MECHANIZATION FOR HYDROMETEOROLOGICAL REGIME STUDY
N. K. Kljukin *In* World Meteorol. Organ. Data Process. for Climatological Purposes 1969 p 126–132 (See N69-36583 21-20)
Copyright. Avail: Issuing Activity

A survey is given of the automatic procedures adopted for data recording, transmission, processing, and storage in the Service of Aeroclimatology and Hydrometeorology of the USSR.
ESRO

N69-36601 World Meteorological Organization, Geneva (Switzerland).
POLAR METEOROLOGY
1967 595 p refs Proc. of the WMO/SCAR/ICPM Symp. on Polar Meteorol., Geneva, 5–9 Sep. 1966 (WMO-211.TP.111; TN-87) Copyright. Avail: Issuing Activity

Conference reports on meteorology and oceanography of Arctic and Antarctic regions are presented. For individual titles, see N69-36602 through N69-36631.
Author (ESRO)

N69-36602 Ballistic Research Labs., Aberdeen Proving Ground, Md.
POLAR ATMOSPHERIC WATER VAPOUR
Emmett J. Pybus and John A. Brown, Jr. *In* World Meteorol. Organ. Polar Meteorol. 1967 p 3–13 refs (See N69-36601 21-20)
Copyright. Avail: Issuing Activity

Rocket and balloon soundings in the trophosphere and stratosphere of atmospheric moisture by means of infrared absorption and dew-point hygrometers in the Arctic and Antarctic regions.
Author (ESRO)

N69-36603 Stanford Research Inst., Menlo Park, Calif.
ATMOSPHERIC WATER VAPOUR MEASUREMENTS ON THE GREENLAND ICE CAP
Elmer Robinson and F. L. Ludwig *In* World Meteorol. Organ. Polar Meteorol. 1967 p 15–28 refs (See N69-36601 21-20) (Contract DA-28-043-AMC-00130-(E))
Copyright. Avail: Issuing Activity.

This paper presents the results of humidity profile measurements made at Camp Century on the Greenland ice cap during the summers of 1964 and 1965. Observations were made at several levels from the surface to 183 feet. The method used in this research involved bubbling measured amounts of air through absolute methanol and subsequent titration for water with Karl Fischer reagent. The absolute values of water vapour concentration covered a wide range, but the vertical profile exhibited characteristic

diurnal trends. Supersaturation with respect to ice occurred on a number of occasions, especially when fog was observed in the area. Supersaturation with respect to water was quite rare.
Author (ESRO)

N69-36604 Environmental Science Services Administration, Silver Spring, Md.
INTERPRETATION OF OZONE MEASUREMENTS AT US ANTARCTIC STATIONS, 1964
William S. Weyant *In* World Meteorol. Organ. Polar Meteorol. 1967 p 29–37 refs (See N69-36601 21-20)
Copyright. Avail: Issuing Activity

During 1964, an expanded programme of ozonesonde observations was undertaken at the U.S. Antarctic stations, Amundsen-Scott (South Pole) and Byrd, supplemented by total ozone measurements using the Dobson ozone spectrophotometer. The 1964 Dobson data show a winter minimum of atmospheric ozone over Antarctica, and an ozone maximum at the time of the spring stratospheric warming. Daily 50-mb temperatures are closely correlated with daily total ozone amounts during the spring. The observed variations in ozone provide some indication that vertical motions may not be the primary mechanism for the spring stratospheric warming and ozone increase, although the limited amount of data renders such a conclusion only tentative. Individual ozonesonde observations are useful in identifying the winter tropopause at times when the vertical temperature distribution does not permit an unambiguous determination. Author (ESRO)

N69-36605 McGill Univ., Montreal (Quebec).
THE INVERSION OVER THE POLAR OCEAN
E. Vowinckel and Svenn Orvig *In* World Meteorol. Organ. Polar Meteorol. 1967 p 39–59 refs (See N69-36601 21-20)
Copyright. Avail: Issuing Activity

There are two main areas of semi-permanent inversion in the world: the subtropical belt and the polar regions. The polar inversions are generally caused by the energy deficit at the surface. The polar inversion is not restricted to the surface layers, however, but reaches about 2,000 m into the atmosphere. The Arctic inversion is maintained in its normal position and intensity both by surface cooling and by subsidence, as well as by warm air advection aloft. The inversion over the Polar Ocean is dominant practically during the whole year. Radiosonde ascent data were used in the present investigation, from the Soviet stations North Pole 4, 6 and 7, and for thirty coastal stations around the Polar Ocean. A slightly stable stratification is found over the Polar Ocean in summer, but conditions change drastically towards winter. Very unstable gradients predominate over the warm waters of the Norwegian-Barents Sea, and a sharp gradient develops towards the Polar Ocean where very strong inversions predominate. The strongest positive vertical temperature gradient (the most intense inversion) is found over the Beaufort Sea and north-west of the Canadian archipelago. The most frequent occurrence of inversion is found towards the Siberian side of the Polar Ocean. Author (ESRO)

N69-36606 Innsbruck Univ. (Austria). Inst. für Meteorologie und Geophysik.
LOW-LEVEL INVERSIONS AT LITTLE AMERICA V, 1957
H. C. Hoinkes *In* World Meteorol. Organ. Polar Meteorol. 1967 p 60–79 refs (See N69-36601 21-20)
Copyright. Avail: Issuing Activity

A statistical study is presented of hourly temperature differences between the surface and 15 meters, and between 1.5 and 15 meters, as recorded by the US Weather Bureau at Little America V, by means of ventilated thermohms in a radiation shield from April 1957 to January 1958. For directions NW and NNW on an average 75 per cent of the temperature increase is concentrated in the layer between surface and 1.5 meters. This type of the vertical temperature profile is described as young 'warm-advection' type. For directions NE over SE to SW i.e., from the Ross Ice Shelf, the ratio is below 0.5, with winds from ENE to SSE approaching linearity best. This inversion type is the mature 'cold-advection' type. Apart from changing net radiation, the consideration of advection processes for winds up to 12 knots is essential for the understanding of inversion types.
Author (ESRO)

N69-36607 Norsk Polarinstitutt, Oslo.
SOME FEATURES OF THE TURBULENCE OVER A SNOW FIELD
Torgny Vinje *In* World Meteorol. Organ. Polar Meteorol. 1967 p 81–88 refs (See N69-36601 21-20)
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It is often assumed that the wind shear produces rotational motions or vortices in the air. In accordance, with this view, zigzag profile is explained in the temperature distribution near the surface. From the profile found at Norway Station, Antarctica certain characteristic figures have been determined, and the calculated transfer of heat which is caused by the rotational motions agrees well with other calculations. The measurements indicate that the displaced elements execute a kind of damped oscillation and that the quotient of the consecutive amplitudes, on an average for the upward- and downward-moving elements, may simply be equal to the Karman constant. For the conditions considered, the net vertical displacement of a disturbed element is found to be of the same order as the mixing length.
Author (ESRO)

N69-36608 International Antarctic Meteorological Research Centre, Melbourne (Australia).
FORMATION, PERSISTENCE AND DISAPPEARANCE OF OPEN WATER CHANNELS RELATED TO THE METEOROLOGICAL CONDITIONS ALONG THE COAST OF THE ANTARCTIC CONTINENT
Warren W. Knapp (Wisconsin Univ.) *In* World Meteorol. Organ. Polar Meteorol. 1967 p 89–105 refs (See N69-36601 21-20)
(Grant NSF GA-287)
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The high resolution infrared radiometer pictures and advanced vidicon camera system photographs from the NIMBUS 1 spacecraft have been used to quantitatively determine temporal changes in the size of polynyas in the sea ice along the coast of Antarctica. Two case studies are presented, the first dealing with an area of open water observed in the Davis Sea north of Mirny, and the second with a polynya found off the MacRobertson Land coast near Mawson. The satellite pictures, together with conventional ice reconnaissance data in these areas, suggests that the formation of these two polynyas is due to specific wind action in a region where fields of large icebergs are grounded in shallow water. In addition, the apparent ability of the high resolution infrared radiometer to distinguish areas of thicker and more concentrated ice is illustrated.
Author (ESRO)

N69-36609 Arkticheskii i Antarkticheskii Nauchno-Issledovatelskii Institut, Leningrad (USSR).
RADIATION REGIME OF THE CENTRAL ARCTIC BASIN
N. T. Chernigovskiy *In* World Meteorol. Organ. Polar Meteorol. 1967 p 107–115 refs (See N69-36601 21-20)
Copyright. Avail: Issuing Activity

Long-term observations of the radiation balance elements at the Soviet and American drifting stations have made possible the determination of the main features of the surface radiation regime of the Central Arctic Basin. Monthly and annual sums of radiation balance components are calculated for different zones of

the Central Arctic Basin on the basis of observational data. The annual course of albedo of various types of drifting ice surfaces is considered, as is the solar radiation absorbed by the Arctic Ocean active layer. Author (ESRO)

N69-38610 Environmental Science Services Administration, Washington, D. C.
THE RECENT DECREASE IN SOLAR RADIATION AT THE SOUTH POLE
E. C. Flowers and H. J. Viebrock *In* World Meteorol. Organ. Polar Meteorol. 1967 p 116–119 refs (See N69-38601 21-20)
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Following a series of sharp oscillations occurring in late November and early December 1963, the intensity of the direct solar radiation at the South Pole decreased markedly. This is believed to be in response to an influx of stratospheric dust from the eruption of Mt. Agung, Bali. Daily measurements of the direct solar radiation at the South Pole from November 1963 to February 1966 are presented to indicate the nature of the initial influx of the dust and the subsequent slow return to near normal conditions. Measurements of the total solar radiation on a horizontal surface for the same time period show a much smaller decrease due to the predominant forward scatter of the radiation intercepted by the dust layer. Author (ESRO)

N69-38611 Melbourne Univ., Parkville (Australia).
RADIATION PENETRATION IN ANTARCTIC PLATEAU AND SEA ICE
Gunter Weller and Peter Schwerdtfeger *In* World Meteorol. Organ. Polar Meteorol. 1967 p 120–141 refs (See N69-38601 21-20)
Copyright. Avail: Issuing Activity

An extensive and essentially continuous programme of micrometeorological observations was carried out simultaneously at two main sites near Mawson during 1965. Together with radiation observations in snow, comprehensive measurements in sea and ablation zone land ice provided representative information for a large area of Antarctica. Knowledge of absorption as distinct from extinction of radiation is essential as the former is responsible for a continuous heat source in a transparent medium exposed to radiation. The thermal diffusion equation then permits an analytical separation of the heat flow resulting from pure conduction to and from the surface and the continuously generated within by the absorption of radiant energy. Although a limited amount of spectrally restricted data was obtained, the main purpose of the sub-surface radiation measurements was as a logical extension of precise thermal energy distribution analysis to the ice and snow below as well as the boundary layer of the atmosphere above. Author (ESRO)

N69-38612 International Antarctic Meteorological Research Centre, Melbourne (Australia).
THE SURFACE RADIATION BALANCE IN HIGH SOUTHERN LATITUDES
J. W. Zillman *In* World Meteorol. Organ. Polar Meteorol. 1967 p 142–171 refs (See N69-38601 21-20)
Copyright. Avail: Issuing Activity

Some preliminary estimates of the broad-scale geographic distribution of the surface radiation balance components are given for the southern oceans and the Antarctic continent. The study is based on a selection of theoretical, semi-empirical and empirical methods applied to the available radiation measurements between 30° and 90°S and to climatological, physical and oceanographic data for the region. A series of maps shows the derived distribution of the various radiation components and some related quantities for the mid-season months of January, April, July and October. Author (ESRO)

N69-38613 Environmental Science Services Administration, Silver Spring, Md.
SUB-SURFACE HEAT FLUX IN THE ANTARCTIC INTERIOR
Bernhard Lettau *In* World Meteorol. Organ. Polar Meteorol. 1967 p 175–188 refs (See N69-38601 21-20)
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Temperature data obtained at the South Pole station in 1958 have been used to determine the sub-surface heat exchange and to obtain the magnitude of the sensible heat flux from the snow into the atmosphere on an hourly basis for several individual two-day periods. It is shown that the snow in the Antarctic interior generally acts as a true but non-homogeneous conductor of heat, and that non-conductive effects are limited to the uppermost ten centimetres of snow. It has been found that on individual occasions during the polar night, in the absence of solar radiation, the flux of heat at the 5 cm and 10 cm depths is downward into the snow in contrast to the normal upward flux. Furthermore, the thermal diffusivity varies quite considerably with depth, reaching a maximum value at a depth of 10 cm, while the thermal conductivity varies relatively little with depth. This implies a complex density structure and irregular heat exchange processes in the near-surface levels of the snow. Author (ESRO)

N69-38614 Main Geophysical Observatory, Leningrad (USSR).
THE HEAT BALANCE OF THE ANTARCTIC CONTINENT
I. D. Kopanev
1967 p 189–195 refs (See N69-38601 21-20)
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In the present work the results obtained under the guidance of the author during the Second Soviet Antarctic Continental Expedition, 1956–1958, are described. The annual radiation balance of the snow surface of the Antarctic continent is negative. The heat flux caused by the vertical turbulent exchange plays an important role in the processes of heating and cooling the snow surface and the atmospheric layer near the ground. The heat fluxes in the snow cover are small. In summer they are directed downward and in winter upward. The small temperature gradients in the upper snow layer seem to be explained by the fact that phase transformations proceed slowly and the latent heat released is quite enough for compensation of the loss of snow heat and the decrease in temperature gradient. Author (ESRO)

N69-38615 National Science Foundation, Washington, D. C.
THE RADIATIVE FACTOR IN THE MEAN MERIDIONAL CIRCULATION OF THE ANTARCTIC ATMOSPHERE DURING THE POLAR NIGHT
Fred D. White, Jr. and Reid A. Bryson (Wisconsin Univ.) *In* World Meteorol. Organ. Polar Meteorol. 1967 p 199–224 refs (See N69-38601 21-20)
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Vertical motions play a major role in the distribution of atmospheric energy. In the Antarctic, during the polar night, the radiative downward flux is approximately constant so that a close examination of the related meridional circulation is possible. Periodic upper-air radiometer and rawinsonde observations have recently become available for three Antarctic locations during a four-year period, 1959–1962. Vertical velocities are inferred from these radiation observations and standard meteorological measurements, and an estimate is obtained for the resulting Antarctic meridional circulation during the polar night. The net radiation is used as a measure of the diabatic heating. A simplified model is developed, which shows two meridional cells, one in the troposphere and a much weaker one in the stratosphere. Vertical velocities, based on the model developed, provide an upper limit to the mean ageostrophic meridional circulation which may be found in the Antarctic during the polar night. Author (ESRO)

N69-36616 Wisconsin Univ., Madison. Dept. of Meteorology.
TEMPERATURE VARIATIONS AND VERTICAL MOTION IN THE FREE ATMOSPHERE OVER ANTARCTICA IN THE WINTER
G. Kutzbach and W. Schwerdtfeger *In* World Meteorol. Organ. Polar Meteorol. 1967 p 225-248 refs (See N69-36601 21-20)
(Grant NSF GA-109)
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An analysis of the temperature and thickness field over Antarctica in the winter reveals that the upper troposphere and lower stratosphere over the western part of the continent and the Atlantic sector is considerably colder than at comparable latitudes of the Ross Sea area. In order to understand these average conditions, the present study investigates the heat budget of the air masses of the upper troposphere. With the 12-hourly rawinsonde ascents, the radiometer soundings made at the South Pole, Byrd and Hallett, and all other pertinent observations for July and August 1962, one can compute the thermal advection and local temperature changes, and estimate the other, smaller components of the heat budget. The 12-hourly vertical motion values can then be determined as a balance requirement of the budget. A classification of the frequently recurring general synoptic situations or circulation types over Antarctica appears to be meaningful.
Author (ESRO)

N69-36617 Hydrometeorological Service of the USSR.
ON OROGRAPHIC DISTURBANCES OF THE EASTWARD AIR TRANSPORT GENERATED BY THE RELIEF OF ANTARCTICA
V. A. Bugaev and Sh. A. Musaeljan *In* World Meteorol. Organ. Polar Meteorol. 1967 p 250-262 refs
Copyright. Avail: Issuing Activity

A simple linear scheme for the calculation of non-zonal disturbances generated in a zonal flow by the relief of Antarctica is discussed. Stationary solution of the vorticity equation, linearized relative to the eastward flow, is used for the calculation of non-zonal disturbances. The vorticity equation was transformed, taking into account the boundary conditions. Calculations done for the various atmospheric circulation indices showed that the relief of Antarctica can produce considerable non-zonal disturbances in the zonal flow. The intensity and the spatial distribution of such disturbances depend upon the circulation index. Both areas of low and of high pressure are formed, as a result of the orographic disturbances in Antarctica, in the circumpolar region of the southern hemisphere.
Author (ESRO)

N69-36618 Hydrometeorological Service of the USSR.
TYPES OF SYNOPTIC PROCESS AND ASSOCIATED WIND FIELDS IN OCEANIC REGIONS OF THE SOUTHERN HEMISPHERE
N. G. Davidova *In* World Meteorol. Organ. Polar Meteorol. 1967 p 263-291 refs (See N69-36601 21-20)
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The present classification of synoptic processes has been made for the three oceans of the southern hemisphere (from 20°S to the Antarctic coast) on the basis of synoptic data for 1956-1958. Six types of synoptic process have been revealed for the south Atlantic, five types for the southern part of the Indian Ocean, seven types for the south Pacific. Average charts of pressure and wind fields have been constructed for every type. Types of synoptic process are subdivided into two main groups, zonal and meridional. In all oceans of the southern hemisphere the meridional processes dominate through the whole year, but their mean duration is small (2-3 days). The circulation index computed according to A. L. Katz's method confirms the qualitative subdivision of all types of circulation into zonal and meridional types. It is shown also that the intensity of zonal circulation in the Pacific is weaker than that in the Atlantic and Indian Oceans. As a result of a comparison of the circulation indexes for the northern and southern parts of the Pacific and Antlantic Oceans it follows that the intensity both of zonal and meridional circulation in the southern hemisphere (Pacific and Atlantic Oceans) is much greater than that in the northern hemisphere. This difference is particularly appreciable in the Pacific, where the values of zonal and meridional indexes in the southern part are much greater than in the northern part.
Author (ESRO)

N69-36619 Japan Meteorological Agency, Tokyo.
SOME RELATIONS BETWEEN THE BEHAVIOUR OF THE POLAR VORTEX AND LONG-RANGE WEATHER FORECASTING
H. Wada and T. Asakura *In* World Meteorol. Organ. Polar Meteorol. 1967 p 292-303 refs (See N69-36601 21-20)
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The results of a study for the summer weather forecasting in Japan are presented, applying the behavior of the polar vortex in both the troposphere and stratosphere. In order to clarify the behavior of the polar vortex, the correlation coefficients between 5-day mean 500-mb and 30-mb heights are calculated over the northern hemisphere for the winter season. The result shows that the polar vortex generally extends up to the stratosphere in the polar night régime, except in the period of sudden warming.
Author (ESRO)

N69-36620 Seville Univ. (Spain).
UPPER AIR OBSERVATIONS AT GONZALEZ VIDELA STATION, ANTARCTICA, DURING 1961
Manuel Puigcerver *In* World Meteorol. Organ. Polar Meteorol. 1967 p 307-323 refs (See N69-36601 21-20)
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Some results of upper-air observations carried out at González Station, Antarctica, during 1961, are presented. Temperature is discussed in terms of monthly mean ascents, typical individual ascents, a temperature time-section and temperature distribution at several selected pressure levels, for which frequency-distributions and standard deviations are also given. Although differing in details, the temperature distribution shows essentially the same features as those for more southerly stations. An early, temporary warming is detected in the first two decades of August, above 100 mb. Monthly mean geopotentials and standard deviations for several pressure levels are considered. A surprisingly high percentage of ill-defined tropopauses is found, the peak value occurring in September.
Author (ESRO)

N69-36621 National Center for Atmospheric Research, Boulder Colo.
THE ANTARCTIC TROPOPAUSE
Gene D. Prantner *In* World Meteorol. Organ. Polar Meteorol. 1967 p 324-344 ref (See N69-36601 21-20)
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This paper reports preliminary results of a program designed to investigate spatial and temporal variations of the Antarctic tropopause on several different scales over the five-year period 1958-1962. The radiosonde data were processed to yield tropopause height and temperature for each observation as well as monthly means and standard deviations. It is evident from this study that the Antarctic tropopause assumes a wide range of values both spatially and temporally. It is clear that the largest variation from month to month occurs over the high plateau region of the interior with generally smaller values being common along the coast of the continent.
Author (ESRO)

N69-36622 Hydrometeorological Service of the USSR
PERIODICITY IN ATMOSPHERIC CIRCULATION AND STRATOSPHERIC WARMINGS OVER ANTARCTICA
L. A. Zhdanov *In* World Meteorol. Organ. Polar Meteorol. 1967 p 345–363 refs (See N69-36601 21-20)
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500-mb geopotential data over Antarctica, averaged for a five-year period (1958–1962), revealed one climatic cyclone with the center located inside the triangle formed by stations Vostok, Amundsen-Scott and McMurdo. Periodicities in the atmospheric circulation are described. Stratospheric warmings occur during periods of increased cyclonic activity, and appear to be preceded by a small temperature increase in the troposphere and the lower stratosphere up to the 100-mb and 50-mb levels. In the lower stratosphere the circumpolar vortex over Antarctica does not break down into two centers during stratospheric warming periods as is usually observed over the Arctic, where the powerful cyclonic systems in the northern hemisphere can reach central Arctic areas. Author (ESRO)

N69-36623 Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Meteorological Physics.
MERIDIONAL INTERACTIONS IN THE QUASI-BIENNIAL STRATOSPHERIC OSCILLATION SOUTH OF THE TROPICS
F. A. Berson *In* World Meteorol. Organ. Polar Meteorol. 1967 p 364–378 refs (See N69-36601 21-20)
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Quasi-biennial wind cycles in the lower stratosphere are examined concerning their association with anomalies of spring-time warming in the Antarctic region from data in the Australian longitude sector of the southern hemisphere. In the eight-year data period 1957 to 1964, the biennial rhythm of zonal wind was best developed during the years 1958 to 1962, which were followed by a decline at all latitudes except south of the Antarctic circle. This decline was simultaneous with the breakdown of the biennial cycle in total-zone amount at middle latitudes reported by Kulkarni (1966). Correlations between ozone and stratospheric zonal winds for the peak oscillation indicate intensified meridional interactions, i.e. in the biennial mode. An order-of-magnitude assessment is made of biennial (spring-time) variations in zonal angular momentum and meridional eddy-transport of momentum in the lower stratosphere, and its implications for interchange with the northern hemisphere are briefly discussed. Author (ESRO)

N69-36624 International Antarctic Meteorological Research Centre, Melbourne (Australia).
SOME FURTHER OBSERVATIONS ON ANTARCTIC STRATOSPHERIC WARMING
H. R. Phillpot *In* World Meteorol. Organ. Polar Meteorol. 1967 p 379–406 refs (See N69-36601 21-20)
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The general stratospheric circulation over the Antarctic is characterized in winter by a strong polar vortex and in summer by a generally weak circulation. In spring the breakdown of the vortex and the behavior of the warming show marked variation from year to year, although not as great as in the north polar region. There are three particular synoptic problems about which more information is required on the broadest scale, namely (i) why marked differences occur from year to year in the onset of the spring warming, (ii) whether the Antarctic warming invariably occurs first in the Indian Ocean, Australia sector and (iii) whether a relationship exists between stratospheric warming and tropospheric behavior. The results obtained from correlating the 50-mb mean monthly zonal wind anomaly at each of several stations in the latitude range 2°N to 66°S, with 50-mb mean monthly temperature anomaly in the Mirny/Wilkes sector are given, and significant differences in the nature of the broad-scale high latitude flow in the winter and spring months of 1964 and 1965 are demonstrated by mean monthly isentropic charts. Temperature data obtained from the TIROS 7 satellite show the early behavior of the warming in the spring period of 1963. Author (ESRO)

N69-36625 Central Aerological Observatory (USSR).
ON STRATOSPHERIC WARMINGS IN THE ANTARCTIC AND ARCTIC
S. S. Gaigerov *In* World Meteorol. Organ. Polar Meteorol. 1967 p 407–415 refs (See N69-36601 21-20)
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A comparison is made between stratospheric data obtained in the Arctic and Antarctic. In winters with intense development of northern hemisphere cyclonic vortex, the Arctic stratospheric regime is characterized by some features common to the Antarctic stratosphere. Special consideration is given to the processes of winter stratospheric warmings and spring transformations in the Antarctic and Arctic. Author (ESRO)

N69-36626 National Center for Atmospheric Research, Boulder, Colo.
SUMMARY OF A PAPER ON THE HALF-YEARLY OSCILLATION OF THE SEA-LEVEL PRESSURE IN MIDDLE AND HIGH SOUTHERN LATITUDES
Harry van Loon *In* World Meteorol. Organ. Polar Meteorol. 1967 p 419–427 refs (See N69-36601 21-20)
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The surface pressure variations with a semi-annual periodicity, occurring in middle and high southern latitudes, are correlated to the seasonal variations in the cyclonic activity near Antarctica. Such pressure variations will show up in changes in mean surface wind velocity at a given parallel close to the northernmost position of the circumpolar through, in the sense that when the through moves northward the wind will weaken, and conversely. ESRO

N69-36627 Meteorological Office (Gt. Brit.)
ON CLIMATIC VARIATIONS AFFECTING THE FAR SOUTH
H. H. Lamb *In* World Meteorol. Organ. Polar Meteor. 1967 p 428–453 refs (See N69-36601 21-20)
Copyright. Avail: Issuing Activity

A history of more than 100 years' observations can be presented in summary form for some aspects of the wind circulation, the precipitation in certain areas and the incidence of sea ice and bergs in temperate and higher latitudes of the southern hemisphere. Variations are found which show relationships to the known climatic variation over other parts of the world, and this applies in particular to the measurements of the accumulation of snow at the South Pole. On the basis of observational data from many parts of the world, the general picture of climatic changes in recent times may be described as: (i) a general rise of annual mean surface temperature from 1840 or earlier to about 1940, the warming having been strongest in the Arctic, accompanied by (ii) an increase in strength of the mean circulation of the atmosphere. There seems to have been a reversal of both the foregoing changes (i) and (ii) in most parts of the world since about 1940. Author (ESRO)

N69-36628 Arcticheskii i Antarkticheskii Mauchno-Issledovatelskii Institut, Leningrad (USSR).
ON PECULIARITIES OF THE ARCTIC METEOROLOGICAL REGIME IN DIFFERENT STAGES OF THE CIRCULATION EPOCH OF 1949–1964
A. A. Girs *In* World Meteorol. Organ. Polar Meteorol. 1967 p 454–477 refs (See N69-36601 21-20)
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Data on the variations of pressure and air temperature anomalies, observed in the change of circulation epochs in the

northern hemisphere, primarily in the Arctic, are presented. The last circulation epoch (1949–1964) and its main stages (1949–1951, 1952–1956, 1957–1960, 1961–1964) are analyzed in detail. The probable character of a future epoch is suggested. Some features revealed in the last epoch (1949–1964) are shown to pertain to this coming epoch. Author (ESRO)

N69-36629 Arkticheskii i Antarkticheskii Nauchno-Issledovatelskii Institut, Leningrad (USSR).

ON THE ORIGIN OF THE ATMOSPHERIC ACTIVITY CENTRES

I. V. Maximov *In* World Meteorol. Organ. Polar Meteorol. 1967 p 481–491 refs (See N69-36601 21-20)

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When considering the problem of possible influences of compression forces on sea-level surface position, it is necessary to use the equation for the latitudinal part of the potential of the earth's centrifugal force. The deformation of the world's sea-level surface can be calculated, depending on the gravity anomaly distribution on the earth's surface. Using the gravity anomalies known for many regions of the northern hemisphere, and after computation of their probable values for all the ten-degree squares of the northern hemisphere and the deviations of the anomalies from their average values in the given latitudes, it is possible to calculate gravitational anomalies of sea-level surface position for the whole northern hemisphere, assuming that the ocean covers the whole earth. The calculated anomalies are shown in the paper, and also their correspondence to air pressure anomalies. Author (ESRO)

N69-36630 Melbourne Univ., Parkville (Australia). Dept. of Meteorology.

ELECTROSTATIC CHARGING OF AERIAL WIRES DURING ANTARCTIC BLIZZARDS

E. R. Wishart (Dept. of External Affairs, Melbourne) and U. Radok *In* World Meteorol. Organ. Polar Meteorol. 1967 p 492–529 refs (See N69-36601 21-20)

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Instrumentation used in the study at Mawson, Antarctica, of electrical phenomena in blizzards, first reported by Barre (1954) for Port Martin, is described. Currents produced in 5 identical aerials at heights from 0.5 to 8 m above the snow surface demonstrate the emergence in protracted blizzards of a characteristic vertical current profile with maximum positive values near the 1-m level and vanishing or negative currents at 8 m and above. In order to explain the vertical profile of particle charges now held responsible for the aerial currents three separate charging mechanisms are deduced from the ice temperature gradient theory of Latham and Mason (1961 a). It is concluded that ground drift tends to be charged mainly by asymmetric rubbing with the snow surface and perhaps also by the large temperature gradient often found in the surface layer, whereas the dense drift in full blizzards acquires its charges mainly during the collisions between drift particles of different sizes which tend to be separated along the vertical by turbulence. It seems likely that near the snow surface the first and third effects would counteract one another and thus produce the observed charge maximum near the 1-m level. A complete study of blizzard electricity is outlined which could confirm these surmises. Author (ESRO)

N69-36631 Washington Univ., Seattle. Dept. of Atmospheric Sciences.

RESULTS OF A CONTINUING ARCTIC METEOROLOGY PROGRAMME

In World Meteorol. Organ. Polar Meteorol. 1967 p 530–540 refs (See N69-36601 21-20)

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This report summarizes the content of nearly fifty published reports on polar meteorology and various aspects of sea-air intdaction in the Arctic, including the heat budget, the drift and the physical properties of sea ice. The first series of investigations deals with the circulation of the atmosphere in the Arctic and is collated in a comprehensive manual on Arctic weather analysis and forecasting. Several years of continuous recordings of atmospheric carbon dioxide and ozone have established the annual ranges of concentration and, in the case of carbon dioxide, a significant increasing trend of the annual averages. Two reports treat the steady-state drift of sea ice under the action of wind and water stresses. From IGY to the present, a number of studies have been devoted to the over-all heat and ice budget of the Arctic Ocean surface, including detailed oceanographic observations of the first few hundred meters of water, measurements of radiation, the turbulent fluxes in the atmospheric boundary layer, and computations of the temperature régime and heat conduction in sea ice. Some of the more specialized topics of research have been the heat exchange of open water surrounded by pack-ice, the modification of the boundary layer over inhomogeneous surfaces, measurements of radiative flux divergence near the ground, eddy diffusion and density profile of wind-blown snow, computations of the dynamics of a storm surge at Barrow, Alaska, and several problems concerning the crystal structure, phase relationships, and natural desalination of sea ice. Author (ESRO)

N69-36664# Joint Publications Research Service, Washington, D.C.

METEOROLOGY

In its Soviet-Bloc Res. in Geophys., Astron., and Space, No. 207 1 Jul. 1969 p 3–14 refs (See N69-36662 21-20)

Avail: CFSTI

Experimental methods and apparatus for studying air turbulence, atmospheric composition, radiation transmission and absorption, and atmospheric brightness effects are discussed. The feasibility of using gravimetric ground evaporators in desert areas is shown. A monogram is constructed to compute heat protection characteristics of clothes. Schemes for numerical weather forecasting are briefly outlined. G.G.

N69-36672*# Techtran Corp., Glen Burnie, Md.

THE METEOR EXPERIMENTAL SPACE METEOROLOGICAL SYSTEM

I. M. Andronov et al [1969] 17 p Transl. into English from Russian Paper Presented at the UN Conf. Exploration and Peaceful Uses of Outer Space, Vienna, 14-27 Aug. 1968 *Its* no. 41 (Contract NAS5-14826) (NASA-CR-105628) Avail: CFSTI CSCL 04B

The Soviet experimental meteorological satellite system, Meteor, has been functioning for more than one year; an appraisal of the background space engineering experience with the first Kosmos satellites and an analysis of the space-borne and ground support systems for the Meteor system are described. Specialized characteristics and requirements of functioning space observatories are discussed. The satellite's orientation system, the space-borne power plant (BEU), the meteorological apparatus, and the space-borne programming and timer device (BPVU), are discussed in general terms with examples of the on-board position of these systems denoted in a photograph of Kosmos-144. A schematic drawing showing the reciprocal positioning of the orbits of Kosmos-144 and Kosmos-156 is included. Longevity and high reliability during the lifetime of the satellite observatory system are explained by the simplification of the system's logic and function structure, efficiency-designed layouts for electronic devices and instruments, and built-in functional reserve. M.H.E.

N69-36676 World Meteorological Organization, Geneva (Switzerland).
DESIGN OF OPTIMUM NETWORKS FOR AEROLOGICAL OBSERVING STATIONS
L. S. Gandin, S. A. Meshkovich, M. A. Alaka, and F. Lewis 1969 67 p refs Reprinted *Its* World Weather Watch Planning Rept. No. 21 Copyright. Avail: Issuing Activity.

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1. DESIGN OF OPTIMUM NETWORKS FOR AEROLOGICAL OBSERVING STATIONS p 1–25 refs (See N69-36677 21-20)
2. A SURVEY OF STUDIES OF AEROLOGICAL NETWORK REQUIREMENTS M. A. Alaka (ESSA, Silver Spring, Md.) p 27–42 refs (See N69-36678 21-20)
3. A PRELIMINARY ASSESSMENT OF THE WORLD WEATHER WATCH OBSERVATIONAL NETWORK FOR 1968–1971 p 43–58 (See N69-36679 21-20)

N69-36677 World Meteorological Organization, Geneva (Switzerland).
DESIGN OF OPTIMUM NETWORKS FOR AEROLOGICAL OBSERVING STATIONS
In its Design of Optimun Networks for Aerological Observing Sta. 1969 p 1–15 refs (See N69-36676 21-20)
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The primitive equation and barotropic-mesh models are used to determine the optimum distance between meteorological stations in a worldwide forecasting system. By processing observations of a meteorological element at different points, the autocorrelation function can be calculated depending on the distance between these points. Optimum interpolation is then used to determine characteristic distances between stations. The results obtained are of special importance for the tropics and further work on this problem is suggested. Author (ESRO)

N69-36678 Environmental Science Services Administration, Silver Spring, Md. Techniques Development Lab. Systems Development Office.
A SURVEY OF STUDIES OF AEROLOGICAL NETWORK REQUIREMENTS
M. A. Alaka *In* World Meteorol. Office Design of Optimum Networks for Aerological Observing Sta. 1969 p 27–42 refs (See N69-36676 21-20)
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Errors in meteorological observations are due to three sources, i.e. atmospheric structure, the accuracy of instruments, and technique of analysis. In analysis, the spacing of weather stations is a main factor, and therefore, the variation of errors as depending upon station spacing is investigated. The influence of amplification of initial errors, and interpolation schemes are discussed. As the different results exhibit great disparity, further work on the problem is recommended. ESRO

N69-36679 World Meteorological Organization, Geneva (Switzerland).
A PRELIMINARY ASSESSMENT OF THE WORLD WEATHER WATCH OBSERVATIONAL NETWORK FOR 1968–1971
In its Design of Optimum Networks for Aerological Observing Sta. 1969 p 43–58 Presented at the WMO Informal Planning Meeting, Geneva, 5–9 Sep. 1966 (See N69-36676 21-20)
Copyright. Avail: Issuing Activity

Several approaches to the problem of determining optimum spacing of weather stations are discussed, one method being based on the scale of atmospheric motions, the second on statistical analysis, and the third one on experimental procedures (simulation). The proposed spacing is 600–700 km. ESRO

N69-36717# Hawaii Inst. of Geophysics, Honolulu.
STRUCTURE OF THE TROPOSPHERE OVER SOUTHEAST ASIA DURING THE SUMMER MONSOON MONTH OF JULY
Barry E. Harris (AF) and Francis P. Ho Feb. 1969 46 p refs
(Contract F19628-67-C-0232)
(AD-688915; SR-3; HIG-69-4; AFCRL-69-0081) Avail: CFSTI CSCL 4/1

Mean aerological data for Saigon during July 1966 and 1967 and for Udorn in 1967 are presented and compared with similar data for tropical maritime regions. The comparison indicates that level for level the atmosphere over Southeast Asia has greater humidity and higher static energy. Comparison of dewpoint profiles taken during periods of suppressed and increased convection over Southeast Asia reveals that the atmosphere is more moist during increased convection and that the diurnal variation of humidity is largest during suppressed conditions. Comparisons of vertical profiles of virtual equivalent potential temperature taken during periods of suppressed and increased convection show that the daily convective instability is strong during suppressed days and weak during days of increased convection. The characteristic differences in structure as shown, suggest convection is controlled by the synoptic scale. Author (TAB)

N69-36748# Weapons Research Establishment, Salisbury (Australia).
THE VARIATION OF OPTICAL REFRACTION AT LOW ELEVATION ANGLES
M. S. Brown Feb. 1969 27 p refs
(WRE-TN-PD-99) Avail: CFSTI

The use of an average temperature profile in the calculation of refraction errors is discussed. The effect of average temperature gradients measured at Woomera is calculated for a variety of sightlines. The results show that at very low elelvation angles the magnitude of the refraction error does not necessarily increase when the sightline length is increased. Author

N69-36976*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QUADRATURE VARIATIONS IN DISCRETE-ORDINATES CALCULATIONS
Robert E. Sullivan Washington Sep. 1969 19 p refs
(NASA-TM-X-1887) Avail: CFSTI CSCL 12A

Techniques to reduce computer time required to solve the Boltzmann transport equation in the discrete ordinates (S_n) approximation were studied. These techniques are based on initial use of low-order angular quadrature or spatial mesh to generate preliminary neutron flux distributions which are then converged in the high-order detail required of the final calculation. Results indicate that these modifications to the standard S_n method can decrease problem execution times and yield results which are as accurate as those obtained with the standard method. Author

N69-36978# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
PRECIPITATION PRODUCED BY GRAVITATIONAL COALESCENCE IN SHALLOW WARM CLOUDS UNDER FLUCTUATING CONDITIONS
Hua-Ying Hus et al Bedford, Mass. AFCRL Apr. 1969 19 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 33, no. 1, 1963 p 108–114
(Contract F19628-68-C-0251)
(AD-688219; EMM-69-214; AFCRL-69-0141; Trans-43) Avail: CFSTI CSCL 4/2

An evaluation of the droplet growth by gravitational coalescence is made by taking into consideration the effect of the eddy fluctuations in the vertical currents. It is found that under the influence of the fluctuating upcurrents, cloud droplets may grow

to larger drops of different sizes ranging from minute precipitating elements to raindrops. A more reasonable explanation of the formation of rain in shallow warm clouds is then suggested. Author (TAB)

N69-36983*# Travelers Research Center, Inc., Hartford, Conn.
RESEARCH TO DETERMINE CLOUD AND SYNOPTIC PARAMETERS ASSOCIATED WITH CLEAR AIR TURBULENCE Interim Report
Duane S. Cooley and John T. Ball Jul. 1969 78 p refs
(Contract NAS12-699)
(NASA-CR-86229; Rept-7498-382) Avail: CFSTI CSCL 04B

The relationships between clear air turbulence (CAT) in the stratosphere and upper troposphere with meteorological variables, circulation data and cloud features were studied. The principal turbulence data used were instrumented reports of CAT in the 45,000- to 70,000-ft layer. Approximate quantitative specifications were determined for ranges of parameters representing vertical variation of wind and temperature derived from rawinsonde observations. Large values of wind shear and negative values of temperature lapse rate or irregular lapse rate in the stratosphere were often associated with at least light to moderate intensity of CAT. Significant stratospheric CAT appears also to be associated with strong southwesterly flow and with banded and cumulonimbus clouds. Author

N69-37035# Library of Congress, Washington, D.C. Aerospace Technology Div.
SURVEYS OF FOREIGN SCIENTIFIC AND TECHNICAL LITERATURE: COMMUNIST-BLOC METEOROLOGICAL SYSTEMS AND SENSORS
Lee Boylan 18 Jun. 1969 124 p refs
(AD-689396; ATD-68-118) Avail: CFSTI CSCL 4/2

The present compilation of abstracts is devoted to the study of Soviet-bloc weather systems and sensors. The report is devided into three major parts. Part I deals with the status and future development of some aspects of the Soviet Hydrometeorological Service. Part II reviews the computer processing of weather data. In Part III, the material is limited strictly to instruments and sensor systems. These are arranged in functional groupings and include instruments for measuring the following: pressure, temperature, wind, humidity, precipitation, dew, cloud height, ozone, radiation, visibility, and waves. Author (TAB)

N69-37162# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN FEATURES OF WIND CONDITIONS IN THE SOUTHEAST OF WESTERN SIBERIA
S. A. Sapozhnikova 6 Mar. 1969 25 p refs Transl. into ENGLISH from Tr. Nauchn-Issle. Inst. Aeroklimatologii (Moscow), No. 37, 1966 p 3–15
(AD-688091; FTD-MT-24-456-68) Avail: CFSTI CSCL 4/1

An analysis is made of the distribution of prevailing wind directions, average wind speeds, and the change with altitude of wind speeds in the boundary layer of the atmosphere over the southeastern part of West Siberia. The principal purpose of the study was to analyze the effect of station sites on meteorological element measurements. The basic data consisted of average wind speeds and frequencies of various wind directions measured at 107 weather stations and at 20-40 other stations at which more complex characteristics were machine-computed. The data were collected mostly in the 1936-1960 period with observations made every four hours. Much of value in this paper is contained in the numerous tables and figures. TAB

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also 07 Communications.

N69-36001*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.
LOCATED HORIZON VARIATION STUDY Final Report, 20 May 1968–13 Jan. 1969
L. G. Bradfield and G. D. Nelson Jan. 1969 145 p refs
(Contract NAS1-8102)
(NASA-CR-66748) Avail: CFSTI CSCL 17G

Interpolation techniques used to generate meteorological data for use in computing horizon radiance profiles were examined in order to determine if these techniques introduced artificial variations in the located horizon altitudes. In addition, data generated over a three-year span were analyzed to determine whether such artificial variations occur over periods longer than one year. A total of 697 profiles were generated for 1964, 1965, and 1966, consisting of actual meteorological data from radio- and rocketsondes and of meteorological data interpolated in time and space from these sensor sources. Interpolation provided a data base with sufficient resolution to determine temporal and spatial frequency variations in the horizon altitudes. The located horizon altitudes were compared with the corresponding temporal and spatial subsets. Results showed that the interpolation techniques did not significantly affect the accuracy of the study. Year-to-year variations occur at the high latitudes over North America, and variations in the equatorial regions show evidence of the quasi-biennial cycle. K.W.

N69-36227*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXPERIMENTS IN PILOTING BY LANDMARK ON THE MOON
Ritchie Coryell and David Rubin 1 Apr. 1969 58 p refs
(Contract NAS7-100)
(NASA-CR-105620; JPL-760-37) Copyright. Avail: CFSTI CSCL 17G

The feasibility of the landmark navigation scheme depends on whether landmarks can be identified by TV imagery, taken from the ground, and whether measurements deduced from the imagery are adequate to direct a vehicle to a predetermined objective. It appears that even a crude test in an earth environment would indicate the general feasibility of the scheme for an automated lunar roving vehicle (LRV). This report fully discusses field test piloting by landmark technique, presents detailed conclusions directly derived from the test, and provides a day-by-day summary of the field experience, as well as including the actual field log. Author

N69-36352*# Polhemus Navigation Sciences, Inc., Burlington, Vt.
NAVIGATION/TRAFFIC CONTROL STUDY FOR V/STOL AIRCRAFT. VOLUME 1: SUMMARY Final Report
Mar. 1969 88 p
(Contract NAS12-2024)
(NASA-CR-86218; PNSI-TR-69-0301-I) Avail: CFSTI CSCL 17G

The navigation traffic control study for V/STOL aircraft developed recommendations for the further research and development of air traffic control/navigation related technology. The desired performance characteristics of an advanced navigation/air traffic control system for the 1975–1985 domestic air transportation environment were developed from the cockpit viewpoint. The V/STOL, CTOL-jet, SST, and general aviation

aircraft were considered. The advanced system embodies two new concepts: a flight plan reference system, and limit logic. The concepts assume the availability of area navigation aids. Author

N69-36353*# Polhemus Navigation Sciences, Inc., Burlington, Vt.
NAVIGATION/TRAFFIC CONTROL STUDY FOR V/STOL AIRCRAFT. VOLUME 2: TECHNICAL Final Report
Mar. 1969 245 p refs
(Contract NAS12-2024)
(NASA-CR-86219; PNSI-TR-69-0301-II) Avail: CFSTI CSCL 17G

Enroute, terminal area and approach and landing requirements are considered. Area navigation provided two capabilities: required horizontal position information for the pilot, and ATC system-required surveillance information. To generate the precision required for approach and landing of carrier aircraft, a differential NAVSAT and/or ground based hyperbolic capability must be incorporated into the system if individual runway instrumentation is not to be used. Author

N69-36354*# Polhemus Navigation Sciences, Inc., Burlington, Vt.
NAVIGATION/TRAFFIC CONTROL STUDY FOR V/STOL AIRCRAFT. VOLUME 3: APPENDICES Final Report
Mar. 1969 249 p refs
(Contract NAS12-2024)
(NASA-CR-86220; PNSI-TR-69-0301-III) Avail: CFSTI CSCL 17G

Acceptability of each navigation aid is evaluated through use of comparative pilot workload analysis. The pilot workload approach is used to determine desired system level(s) of automation. Detailed event sequence diagrams which cover both VFR and IFR operations define the pilot's tasks of navigation, communication, aircraft control, and system monitoring, and show the interface between airborne system and ATC. To insure a broadly based workload assessment, several configurations of general aviation and air carrier-type avionics systems are included in the tradeoff analyses. Author

N69-36539# National Weather Records Center, Asheville, N.C.
CLIMATOLOGICAL SUMMARIES: VISIBILITIES BELOW 1/2 MILE AND CEILINGS BELOW 200 FEET VOLUME 18: INDIANAPOLIS, INDIANA WIER COOK AIRPORT Final Report
Jun. 1969 31 p
(FAA Order FA-67-WAI-129)
(SRDS-RD-69-22-Vol-18) Avail: Issuing Activity

Tabulated data covering the period 1 January 1965 to 31 December 1965 are presented for the Indianapolis airport. Ceiling, visibility, wind, and weather information are grouped by various periods of the day and by various temperature and wind categories. Weather and landing system categories are tabulated as aids for making decisions affecting landing system and fog dissipation at the air terminal. Author

N69-36759*# Techtran Corp., Glen Burnie, Md.
CONTROL OF MOTION DURING REENTRY INTO THE ATMOSPHERE [UPRAVLENIYE DVIZHENIYEM PRI VKHODE v ATMOSFERU]
D. Ye. Okhotsimskiy et al Washington NASA Sept. 1969 14 p refs Transl. into ENGLISH of Russian Conf. paper, IFAC tech. Sess. no. 49 p 67–83 Presented at the 4th Congr. of the Intern. Federation of Autom. Control, Warsaw, 16-21 Jun. 1969
(Contract NASw-1695)
(NASA-TT-F-12490) Avail: CFSTI CSCL 17G

The problem of the construction of the algorithm of control of the motion of a spacecraft during its return to the earth's atmosphere is discussed. It is assumed that the apparatus is equipped with a stabilized platform with three accelerometers installed on mutually perpendicular axes. Flight control is achieved through changes of the lifting force during changes in the bank of angle. Calculation of the required bank angle is aided by an onboard computer on the basis of analysis of measurement information. Author

N69-36851# Advisory Group for Aerospace Research and Development, Paris (France).
INERTIAL NAVIGATION: SYSTEMS AND COMPONENTS Conference Proceedings
May 1968 568 p refs In ENGLISH and FRENCH Presented at two meetings of the Guidance and Control Panel of AGARD, Oxford, 1967 and Braunschweig, Ger., May 1968
(AGARD-CP-43) Avail: CFSTI

Research and development studies discussed cover components, systems, and applications of inertial navigation in guidance and control of aerospace vehicles. Emphasis is placed on the development of hybrid inertial navigation systems and the increased sophistication of gyroscopes and accelerometers. For individual titles see N69-36851 through N69-36881.

N69-36852# Royal Aircraft Establishment, Farnborough (England).
TECHNIQUES AND PHILOSOPHY OF MIXING OR AIDING INERTIAL NAVIGATION WITH OTHER NAVIGATION AIDS
G. F. Roberts *In* AGARD Inertial Navigation: Systems and Components May 1968 p 1–14 (See N69-36851 21-21) Avail: CFSTI

A broad treatment is given of the requirement for the use of hybrid inertial navigation systems in the light of continual development in the capability of pure inertial systems, and the availability of new nagivation aids and computing techniques. The main characteristics of the pure inertial system are described, with particular emphasis on those aspects of performance and integrity which require the support of other aids, and the advantages and limitations of some early examples of hybrid systems are discussed. Future trends in hybrid inertial navigation systems are discussed, emphasising the important role that modern digital computing techniques are going to have in such systems for both military and civil airborne use. Author

N69-36853# Societe d Applications Generales d'Electricite et de Mechanique, Paris (France).
INERTIAL NAVIGATION FOR LONG DISTANCES [NAVIGATION PAR INERTIE SUR DE LONGUES DISTANCES]
B. de Cremiers *In* AGARD Inertial Navigation: Systems and Components May 1968 p 15–29 In FRENCH (See N69-36851 21-21)
Avail: CFSTI

The adaptability, precision and ease of inertial navigation systems to flight over long distances and the polar zones are described. Operational characteristics of the only two phases of its functioning, alignment and navigation make periodic calibrations unnecessary and applicability equally well in all regions calculations and aviator performance are stated. Transl. by M.H.E.

N69-36854# Air Force Avionics Lab., Holloman AFB, N. Mex. Detachment 1.
COST-OF-OWNERSHIP PHILOSOPHY APPLIED TO INERTIAL NAVIGATION SYSTEMS
W. J. Laubendorfer, R. V. Plank, and E. J. De Nezza *In* AGARD Inertial Navigation: Systems and Components May 1968 p 31–47 refs (See N69-36851 21-21)
Avail: CFSTI

This paper supports the need for a total performance (including reliability and maintainability) cost-of-ownership approach toward inertial navigation system design and selection. In addition, a concept entitled COPE (cost-of-ownership performance) is presented, defined, and applied to inertial navigation system design and selection. Author

N69-36855*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRAPDOWN INERTIAL NAVIGATION AT THE MARSHALL SPACE FLIGHT CENTER A Study
F. P. Daniel, G. B. Doane, III, and R. R. Kissel *In* AGARD Inertial Navigation: Systems and Components May 1968 p 49–70 refs (See N69-36851 21-21)
Avail: CFSTI CSCL 17G

The history of inertial navigation contains a trend in which the hardware is becoming progressively more simple mechanically and at the same time more complex electrically. This trend is examined with particular emphasis on large rocket boosters. Attention is given to the generation of meaningful performance specifications. The system chosen at the Marshal Space Flight Center for detailed study and the reasons for its choice are discussed. Methods of statistical data reduction and some comparisons between testing components for a platform and for a strapdown system are presented. Author

N69-36856*# United Aircraft Corporate Systems Center, Farmington, Conn.
DESCRIPTION OF A STRAPDOWN INERTIAL MEASUREMENT UNIT
Joseph Yamron *In* AGARD Inertial Navigation: Systems and Components May 1968 p 71–95 refs Supported in part by NASA (See N69-36851 21-21)

Avail: CFSTI

A strapdown inertial reference package has been developed for space vehicles based on single-degree-of-freedom instrumentation. A number of these packages have been built for the lunar module's abort guidance system. Production-acceptance test data, which include both periodic calibration sequences and environmental tests and data acquired in connection with sled testing, are reviewed. Error sources are examined for boost operations. Development problems encountered to date are highlighted and an assessment is made of strapdown applications. Author

N69-36857# Fluggeraetewerk Bodensee G.m.b.H., Uberlingen (West Germany).
FIELD TEST, ALIGNMENT AND TRIMMING OF THE ELDO-A PLATFORM
Manfred Puetz *In* AGARD Inertial Navigation: Systems and Components May 1968 p 97–108 (See N69-36851 21-21)
Avail: CFSTI

The inertial platform used in the ELDO-A Program has to be tested and aligned prior to launch. This will be done by means of a field test and alignment unit, described in the paper. The field test unit performs all the necessary switching between the platform system and the measuring and recording instruments. For easier operation and for the purpose of documentation all data are delivered digitally and printed. The applied method of the platform alignment starts with coarse alignment by synchro caging. Then the platform is leveled to the local vertical and subsequently aligned to North by closing the gyrocompassing loops. In this mode the calibration of the torquer scale-factors will be performed by aligning the platform in different positions. As a last step of the procedure the two vertical gyros will be trimmed, to achieve alignment accuracy. Author

N69-36858# Societe d Etudes et Conseils AERO, Paris (France).
ERROR PREDICTION OF AN INERTIAL NAVIGATION SYSTEM [PREDICTION DE L'ERREUR D'UNE CENTRALE INERTIELLE]
Miguel da Silveira *In* AGARD Inertial Navigation: Systems and Components May 1968 p 109–118 refs In FRENCH (See N69-36851 21-21)
Avail: CFSTI

An error model for the maximum efficiency optimization of an inertial navigation system is explained in its derivation from Doob's general stochastic process theory, the integration of differential equations systems with Lagrange equations, and the final expression which is the singular model. Errors which result from simplification of the model are plotted to demonstrate that for long-distance flight, the model is uniquely applicable as it stands. Analytical solution requires matrix and scalar methods to achieve coefficients of correction and measurement of error variance. Additionally, the model can be applied to error variance of rectilinear and near uniform flight, and to the correction of vehicle positioning in acceleration. Evidence gained from application of the model to real flight data demonstrates a consistent residual error accumulated in vehicle acceleration contributing to both vertical gyroscope imbalance and the derivation of azimuth data. Trans. by M.H.E.

N69-36859# Elliot Bros., Ltd., London (England). Rochester Airport Works.
FACTORS INFLUENCING THE CHOICE OF COMPUTER FOR AN INERTIAL NAVIGATION SYSTEM
P. Wilson *In* AGARD Inertial Navigation: Systems and Components May 1968 p 119–126 (See N69-36851 21-21)
Avail: CFSTI

The dominance of digital computing techniques available and for the purpose of discussion these are divided into three broad classifications: (1) general purpose computers, (2) digital differential analyzers, and (3) special purpose computers. Each of the classifications is taken in turn and the merits and disadvantages are discussed. The technical merits of the computing system itself, however, are not the only consideration, and many other influences may affect the final choice. Finally, a survey is made of some typical systems and the probable reasons leading to their particular configuration. An attempt is made to forecast the future trend in the light of present day inertial system requirements. Author

N69-36860# Teldix Luftfahrt-Ausruestungs G.m.B.H., Heidelberg (West Germany).
OPTIMAL USE OF REDUNDANT DATA IN INERTIAL NAVIGATION SYSTEMS
F. G. Unger *In* AGARD Inertial Navigation: Systems and Components May 1968 p 127–146 refs (See N69-36851 21-21)
Avail: CFSTI

The performance of inertial navigation systems can be improved by using additional or redundant data from various sensors. Several methods are available to update the inertial navigator, reaching from pure resetting to optimal filtering. These methods, their possible implementations, their different influences on the behavior of the system, and the resulting errors are described. Author

N69-36861# Air Force Missile Development Center, Holloman AFB, N.Mex.
IMPACT OF STATISTICAL ESTIMATION ON INERTIAL NAVIGATION
Larry D. Brock *In* AGARD Inertial Navigation: Systems and Components May 1968 p 147–166 refs (See N69-36851 21-21)
Avail: CFSTI

The application of statistical estimation techniques is one of the more important new developments in inertial navigation. These techniques make possible significant improvement in the performance of a navigation system, even with no change in the quality of the instruments, by allowing the system to continuously calibrate itself. The purpose of this paper is to describe the operation of an onboard statistical filter and discuss some of the practical consequences and problems. First, the basic form of the Kalman recursive filter is reviewed. The basic operation of the filter is then explained using a simplified example. Next, simulation results are shown for a typical air transport navigation problem with an inertial system aided by Doppler radar and position fixes. Several applications and consequences of statistical estimation are then described, and two of the more important practical problems in applying statistical estimation procedures are discussed. Author

N69-36862# Massachusetts Inst. of Tech., Cambridge.
APPLICATION OF INERTIAL TECHNOLOGY TO AIRBORNE GRAVIMETRY
Elmer J. Frey and Raymond B. Harlan *In* AGARD Inertial Navigation: Systems and Components May 1968 p 167–190 refs Supported by AFCRL (See N69-36851 21-21)
Avail: CFSTI

The Massachusetts Institute of Technology undertook to apply the techniques of inertial guidance to airborne gravimetry. Tests of a missile accelerometer used as a gravimeter on a stabilized platform aboard an aircraft ensued. The results of an error analysis of the stabilization and navigation requirements are presented. Navigation requirements are divided into horizontal and vertical coordinates. In the horizontal coodrination, accurate velocity is shown to be the most demanding requirement. In the vertical coordinate, filtering is required to distinguish between gravitational and inertial reaction forces. The design of the experimental gravimetric system is then discussed, with emphasis on the pendulous gyro gravimeter and on the stabilization system. Some results of the flight tests are presented in the form of raw data and reduced observations. Incidental data involving air turbulence and aircraft motion are also presented. Author

N69-36863# British Aircraft Corp., Stevenage (England).
PRESENT DAY NORTH-FINDING SYSTEMS AND THEIR FUNDAMENTAL LIMITATIONS
B. T. Trayner *In* AGARD Inertial Navigation: Systems and Components May 1968 p 191–205 refs (See N69-36851 21-21)
Avail: CFSTI

In the past few years portable gyroscopic north-finders for use on land have evolved which have errors as low as a few seconds of arc. These have mostly been made to meet military needs for survey and gun-laying and civil needs for underground survey. Three basically different types of north-finder have been used in commercial systems which use respectively a pendulous gyro, a single-axis rate gyro and a two-axis rate gyro. The basic principles and method of use of each system are described and the sources of error including those which arise from the environment in which the system is used are outlined. It is indicated that present day systems are limited in accuracy by the environment in which they are used and by the time available as well as by the usual gyro errors. They are limited in their application by their cost and this is the field where most development is likely in the immediate future. Author

N69-36864# Litton Systems (Canada), Ltd., Rexdale (Ontario).
SYSTEM PARAMETERS AS CONSIDERED IN THE DESIGN OF A SMALL INERTIAL NAVIGATION COMPUTER
J. Kydd *In* AGARD Inertial Navigation: Systems and Components May 1968 p 207–230 refs (See N69-36851 21-21)
Avail: CFSTI

The system design of a small digital inertial navigation computer is discussed. The physical layout of the computer is described briefly. Special attention is paid to the factors and trade-offs which established the necessary word size, storage capacity, computing speed, and the interaction of sensor characteristics with those of the computer. The computer operates with whole binary numbers and with a fixed binary point. The computer exploits the CORDIC algorithms for trigonometric computation. Author

N69-36865*# Massachusetts Inst. of Tech., Cambridge.
APPLICATION OF STATISTICAL ESTIMATION TECHNIQUES TO INERTIAL COMPONENT CALIBRATION
George T. Schmidt *In* AGARD Inertial Navigations: Systems and Components May 1968 p 231–249 refs (See N69-36851 21-21)
(Contract NAS9-4065)
Avail: CFSTI CSCL 17G

The calibration of inertial instruments in component, system, and vehicle level tests is shown to be amenable to modern statistical filtering techniques provided adequate models of the processes involved can be found together with some method of solving the immense computation problems. The general form of any calibration system using statistical filtering is given together with techniques for simplifying the computational problem. In one application gyro test table data is processed by a filter and the results compared with a Fourier series analysis. In a second application the design, implementation, and test experience is given for a unique calibration filter used to align and calibrate the Apollo guidance navigation and control system inertial platform while it is in a launch vehicle that is subjected to wind induced sway. Author

N69-36866# Lear Siegler, Inc., Santa Monica, Calif.
EULER ANGLE STRAPPED-DOWN COMPUTER
Alan van Bronkhorst *In* AGARD Inertial Navigation: Systems and Components May 1968 p 251–280 refs (See N69-36851 21-21)
(Contract N00014-67-C-0464)
Avail: CFSTI

A whole number high speed computer, solving three-parameter Euler angle transformations, has been investigated as component of a strapped down mid-course inertial guidance system for a short range missile. An error study showed that the output errors of any strapped down system computer are a function of both its sophistication and the input information which it processes. The strap down computer version can be implemented with a minor increase in memory size; the accuracy of its application is primary a function of quantization partly determined by the vehicle dynamics. Integration with position navigation systems is easy because the three parameters included in the state vector for the transformation process are Euler angles identical to gimbal set update quantities. For many strapped down systems, a vector computer solving a three parameter Euler transformation provides increased flexibility with comparable costs and performance. G.G.

N69-36867# Elliott Flight Automation, Ltd., Borehamwood (England).
A CONCEPT OF DIGITAL AVIONICS
J. F. Bussell *In* AGARD Inertial Navigation: Systems and Components May 1968 p 281–295 (See N69-36851 21-21)
Avail: CFSTI

The purpose of this paper has been to describe the development of an evolutionary generic concept of minimal cost digital avionic modules. In particular the following functions are considered: (1) inertial platform computations; (2) atuomatic flight control; (3) power plant control; (4) head-up display ; and (5) air data. The increasing use of digital devices in aircraft is likely to promote the development of transducers with digital outputs and digitally driven actuators and displays. Author

N69-36871*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
STRAPDOWN GUIDANCE COMPONENT RESEARCH
Richard J. Hayes *In* AGARD Inertial Navigation: Systems and Components May 1968 p 375–400 refs (See N69-36851 21-21)
Avail: CFSTI CSCL 17G

The major advantages of strapdown guidance and control systems over conventional gimbaled systems have been cited as reduced weight, volume, power requirements, cost and packaging flexibility. Also, it has been noted that the major disadvantages are associated with the fact that high angular velocities generate performance errors and the strapdown system requires a very fast computer to avoid non-commutative and truncation errors in the attitude computation. On the basis of these statements, it would appear that strapdown systems hold such significant advantages over gimbaled systems that one would expect to find strapdown systems in wide use today. However, the opposite is true. Gimbaled inertial systems still dominate the guidance and navigation field and probably will continue to do so for several years. Even though the rapid advances in micro-electronics in recent years have made strapdown systems technology more of a reality, many technical problems remain to be solved before the advantages cited above can be fully realized. This paper reviews the results of research efforts conducted by the NASA Electronics Research Center since 1964 in the field of strapdown guidance and control. The technical areas discussed in the paper include gyroscopes, accelerometers, test methods, computers and electro-optical sensors. Author

N69-36872# General Precision Systems, Inc., Little Falls, N.J. Kearfott Group.
GYROFLEX GYROSCOPE
Richard F. Cimera and Michael Napolitano *In* AGARD Inertial Navigation: Systems and Components May 1968 p 401–409 (see N69-36851 21-21)
Avail: CFSTI

The paper presents a general description of the design and construction of the Gyroflex Gyro and some of the highlights and results of evaluation testing of units. In the discussion of component evaluation, both bench and test results and environmental test results are presented. Author

N69-36873# Institut fuer Schwingungsforschung, Tuebingen (West Germany).
ROTOR-VIBRAGYRO
E. Muehlenfeld *In* AGARD Inertial Navigation: Systems and Components May 1968 p 411–418 (See N69-36851 21-21)
Avail: CFSTI

Described is the development of a rotating, two-axis vibragyro with low damping for platform stabilization. Its motor is rigidly mounted and one end of its shaft carries a bearing which allows a resonator to oscillate about an axis perpendicular to the motor axis; the resonator is excited by a torque which is alternating with rotational frequency. The rotational force generates a restoring torque. Rotation about the axis excites the resonator with a phase shift of 90° and can thus be measured. The oscillating deflection relative to the rotor is converted into a signal and registered through an optical pick-up system. For transferring the signal from the rotor to the vehicle, two different optical pick-up systems are found advantageous and the use of two crossed resonators eliminates the effect of torsional vibration of the rotor axis with the ensuing random drift. G.G.

N69-36874# Ferranti, Ltd., Bracknell (England).
THE OSCILLOGYRO
R. Whalley and D. W. Alford *In* AGARD Inertial Navigation: Systems and Components May 1968 p 419–427 refs (See N69-36851 21-21)
Avail: CFSTI

The paper describes a new type of gyroscope suitable for stabilizing a platform in an inertial navigation system or for use as a heading reference. The main feature of the instrument is its inherent simplicity, which promises low cost manufacture coupled with high reliability. In its simplest form the gyro consists of a bar supported at its centre on a single-degree-of-freedom elastic hinge. The bar and hinge assembly are fixed to a motor shaft which is rotated at an accurately controlled speed. A rigorous dynamic analysis of the instrument has been published previously. In this paper the operation of the instrument is described, using simplified mechanical concepts. Author

N69-36879# General Precision Systems, Inc., Pleasantville, N.Y.
AN OPTICALLY PUMPED NUCLEAR MAGNETIC RESONANCE GYROSCOPE
James H. Simpson and I. A. Greenwood *In* AGARD Inertial Navigation: Systems and Components p 517–524 refs (See N69-36851 21-21)
(Contract N00017-67-C-2419)
Avail: CFSTI

The nuclear magnetic resonance (NMR) gyroscope described is a rate integrating single input axis instrument. It has no moving parts; many of its advantages, such as extreme acceleration tolerance and lack of reaction torques arise primarily from this feature. In addition, the nuclear gyro can accommodate large input rate and angle ranges. The sensing element of the nuclear gyroscope, low density mercury vapor, contains a collection of atomic nuclei. The apparent changes in the dynamic behavior of the collection of nuclei measured by the surrounding instrument when it rotates with respect to inertial space provides the rotation sensing instrument when it rotates with respect to inertial space provides the rotation sensing information. The use of two different kinds of nuclei, ^{199}Hg and ^{201}Hg, eliminates the need for very accurate control or knowledge of the magnitude of the applied magnetic field. NMR signals with large signal-to-noise ratios are obtained with only weak (1.2 gauss) magnetic fields through the use of optical pumping for orientation of nuclei and through optical monitoring of the precession motion. The instrumentation of a recently tested experimental model is described. In this model, phase comparisons between output signals from NMR controlled oscillators supply the rotation output information. Design factors affecting random drift rates and application ranges are discussed.

N69-36880# Compagnie Generale d Electricite, Paris (France). Centre de Recherches.
LASER GYROMETERS AND APPLICATIONS [GYROMETRES LASER ET APPLICATIONS]
J. M. Catherin and B. Dessus *In* AGARD Inertial Navigation: Systems and Components May 1968 p 525–536 refs In FRENCH (See N69-36851 21-21)

The gyrometer is composed of a tube in which thin plasma material is susceptible to light amplification. The tube is placed on a close optic cavity. With this design, the uses and applications

of the gyrometer are investigated. Results indicate the system may be used for engine stabilization, inertial navigation and guidance, brief angle measurements, and the direction of the axes in earth rotation measurements. Various other uses are mentioned. Also included are some of the advantages and disadvantages of this system. Trans. by E.H.W.

N69-36881# Sperry Gyroscope Co., Ltd., Bracknell (England).
STATUS AND FUTURE OF FLUID COMPONENTS
D. L. Wright and W. G. Wing *In* AGARD Inertial Navigation: Systems and Components May 1968 p 537–579 (See N69-36851 21-21)
Avail: CFSTI

Various types of fluid gyros and accelerometers are described and their performance analyzed. These instruments possess short reaction times and high over rating capabilities during gyro run-ups, as well as the possibility of eliminating temperature controls and reducing calibration requirements. In detail evaluated are: (1) fluid sphere gyroscopes; (2) fully filled cavities with float; (3) partly filled fluid rotors; (4) vortex gyros; (5) Coriolis acceleration sensors; (6) rotating field elements; (7) fluid tube rate gyroscopes; (8) fluid toroid gyros; (9) vibratory gas gyros; and (10) fluid accelerometers. G.G.

N69-36997*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
AN ACCURATE STRAPDOWN DIRECTION COSINE ALGORITHM
John W. Jordan Washington Sep. 1969 16 p refs
(NASA-TM-D-5384) Avail: CFSTI CSCL 17G

This report presents an efficient algorithm for calculating the direction cosines of a strapdown inertial system. It is suitable for calculation on a general purpose digital computer; it includes a correction for commutativity error, and has no truncation error. Simulation results are included. Author

N69-37029*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADAR ALTIMETER AS A SPACEBORNE NAVIGATION AID
F. Kalil Jul. 1968 57 p refs
(NASA-TM-X-63649; X-834-69-270) Avail: CFSTI CSCL 17G

The feasibility of using a radar altimeter as a spaceborne navigation aid is reported, particularly on manned spacecraft by showing, at least in a cursory way: (1) the areas or mission phases where it could be advantageous; and (2) that the power, antenna size, and other system requirements are both practical and within the present state-of-the-art. Although the mission analyses contained herein are simplified to permit a cursory evaluation of feasibility, there is sufficient information to permit an engineer, unversed in orbital mechanics to make some quick-look, desk computations. Furthermore, the appendices contain some parametric curves for quick-look evaluations of atmospheric drag effects on near-earth spacecraft. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N69-36089# Centro Informazioni Studi Esperienze, Milan (Italy).
DEVELOPMENT PROGRAM ON THE APPLICATION OF STEAM-WATER SPRAY TO REACTOR COOLING. IN-PILE EXPERIMENTS ON STEAM-WATER MIXTURES: EQUIPMENT AND METHODS OF MEASUREMENT Topical Report No. 6
E. Cerrai, F. Gadda, C. Ronchetti, and A. Scaroni Mar. 1968 52 p refs
(Contract EURATOM-056-62-1 RDI)
(EURAEC-2058; CISE-R-139; EUR-3996) Avail: CFSTI

A description is given of equipment and methods used during the work on water chemistry and corrosion under irradiation. The following items are dealt with: methods used for radioactive crud analysis; design and construction of a shielded cell for determining corrosion rate on radioactive corrosion samples; analysis of hydrogen in Zircaloy-2 by vacuum hot extraction technique; and analysis of radiolytic gases by pressure measurements and by on-line chromatography. Author (NSA)

N69-36090# Atomic Energy Establishment, Winfrith (England). General Reactor Physics Div.
THE WIMS MULTIGROUP SCHEME STATUS AND DIFFERENCE BETWEEN VERSIONS
M. J. Roth 1969 9 p refs
(AEEW-M-845) Avail: CFSTI; HMSO: 1s 9d

The present status of the WIMS programme for multigroup lattice calculations is indicated and the differences between different versions are pointed out. The version previously described by Roth, known as WIMS C, is now working on the ICL KDF9 and the IBM 7030 and 360 computers. In WIMS D known errors in WIMS C were corrected and new options introduced, most of which were made specifically to facilitate reactor design calculations. Extensions to the leakage and burn-up calculations should help to make WIMS D more suitable as an assessment tool. WIMS D is now working on the KDF9 and the 7030 computers, while the 360 version is being brought up to WIMS D standard. NSA

N69-36111# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
FAILURE MODES OF ZIRCALOY-CLAD FUEL RODS. PART 2: PROGRAM REVISIONS
P. L. Rittenhouse May 1969 50 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2548) Avail: CFSTI

Revisions are proposed to studies related to the loss-of-coolant accident behavior of the Zircaloy-clad fuel rods in light-water reactors. Research and testing being performed by industry and AEC contractors are reviewed and analyzed in light of the revised program requirements. Author (NSA)

N69-36140 Maryland Univ., College Park.
THE GLOW DISCHARGE DECOMPOSITION OF HYDRAZINE IN A FLOW REACTOR
Forrest Eugene Logan (Ph.D. Thesis) 1968 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-2516

The decomposition of hydrazine in an alternating current glow discharge was studied over a range of flow rates at several discharge currents. Discharge emission spectra from 3000 Å to 6000 Å were measured during hydrazine decomposition. The investigation was performed at pressures between 1.35 and 14.5 mm Hg, the downstream and feed pressures respectively. Discharge currents of 22, 35, and 55 milliamperes were used, with the electrical power being varied from 19 to 60 watts. Residence times, based on pure hydrazine feed conditions, were varied from 0.4 to 2.8

seconds. A large threshold level of decomposition was observed, which was found to be related to the power supplied to the reactor. Sixty-five percent of the hydrazine was found to decompose in 0.016 ampere-seconds. The decomposition emission spectrum observed in this investigation produced relatively strong emissions for the H_{α} line at 6562.8 Å and a NH radical line at 3360 Å. In contrast, all of the NH_2 radical lines were just slightly stronger than background intensity. Reaction rate constants evaluated using the proposed mechanisms and the experimental data showed that hydrazine molecules dissociated into hydrogen atoms and hydrazyl radicals, N_2H_3, rather than into other fragments, more than 98 percent of the time. Dissert. Abstr.

N69-36286# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.

PLUTONIUM UTILIZATION PROGRAM Technical Activities Quarterly Report, Dec. 1968–Feb. 1969

Mar. 1969 78 p refs

(Contract AT(45-1)-1830)

(BNWL-1039) Avail: CFSTI

In this program the following topics were investigated: the effects of burnup on plutonium isotope concentration in Yankee Power Reactor fuel, and the effects of specific power and burnup on defect behavior of vibrationally compacted plutonium oxides. As to the Plutonium Recycle Critical Facility, gold foil activation analysis of neutron flux peaking and dipping in the 13 element core, reactivity worth measurements of the control element, and the neutron noise in the heavy water moderated plutonium oxide–uranium oxide 19 rod cluster were investigated. Fission foil radiation detector development and comparison with the efficiency of boron fluoride proportional counters for neutron flux measurements, specifically, were accomplished. Criticality studies in the measurement of heavy water cooled and moderated 31 and 55 element cores also were conducted for the Plutonium Recycle Test Reactor; the schedule of the Test Reactor for the period December 1968 to February 1969 is included. M.H.E.

N69-36491# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.

NUCLEAR FUEL PARTICLES DOPED WITH INACTIVE FISSION PRODUCTS FOR REGENERATION STUDIES [BRENNSTOFFTEILCHEN DOTIERT MIT INAKTIVEN SPALTPRODUKTEN FUR AUFARBEITUNGSSTUDIEN]

K. Knotik, H. Bildstein, P. Leichter, G. Stolba, and H. Wagner May 1969 10 p ref In GERMAN

(SGAECH-56/1969) Avail: CFSTI

Described is the production of oxide particles which contain besides 90% thorium oxide and 5% uranium oxide also about 5% mixed oxides from the elements zirconium, barium, strontium, yttrium, selenium, cesium, and silicon. These particles simulate the nuclear fuel variable contained in segregated fuel elements after reprocessing. Transl. by G.G.

N69-36758*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

REFLECTOR-BASED POISON-DRUM CONTROL ON EQUAL-SIZE REACTOR CORES FUELED WITH URANIUM-233 AND WITH URANIUM-235

Wendell Mayo and Robert M. Westfall Washington Sep. 1969 18 p refs

(NASA-TM-X-1883) Avail: CFSTI CSCL 18J

Reflector based poison drum control was marginal for a heavily loaded, long life, high temperature, fast spectrum reactor core with a length to diameter ratio of about one and using uranium-235 or uranium-233 in the nitride form. A tantalum based alloy and tungsten were used as fuel pin cladding and internal core support. Beryllium oxide and molybdenum reflectors were considered as were the number of control drums, the drum spacings, and the poison sector thickness for both reactors. A one dimensional transport theory program was used for all reactivity control calculations. Author

N69-36757*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PARAMETRIC STUDY OF LARGE NUCLEAR SURFACE EFFECTS MACHINES

Albert F. Kascak Washington NASA Sep. 1969 41 p refs

(NASA-TM-X-1888; E-4919) Avail: CFSTI CSCL 18K

Some performance estimates of a high speed peripheral jet nuclear powered surface effects machine are described. The calculations incorporate a recently proposed nuclear airplane reactor concept; this high temperature reactor reduces shield weight and eliminates a need for a heavy preheater. Payload fraction and reactor power are calculated for vehicle gross weights from 1000 to 5000 tons, forward velocities from 0 to 250 knots, and clearance heights from 10 to 50 ft. For these ranges, the payload varied from 0 to 60 percent of the gross weight, and the total reactor power varied from 400 to 10,000 NW. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N69-36107# Institut Franco-Allemand de Recherches, St. Louis (France).

SCHLIEREN-OPTICAL METHODS FOR STUDYING THE WAKE OF HYPERVELOCITY PROJECTILES AT LOW PRESSURE [METHODES STRIOSCOPIQUES APPLIQUEES A L'ETUDE DES SILLAGES HYPERSONIQUES A BASSE PRESSION]

H. Royer 8 Oct. 1968 12 p refs In FRENCH; GERMAN summary

(ISL-T-33/68) Avail: CFSTI

The schlieren method proved most suitable for the visualization and study on wakes of hypervelocity projectiles at low pressure (between 0 and 10 torr). An apparatus developed at the institute was able to render wakes of 8 and 5 Torr pressure quite visible. It is proposed to improve the apparatus through a change in its geometry in order to increase luminosity five times. Another method substituted the input shutter by a narrow slit and the output shutter by a slanted plane mirror to obtain a phase shift of 180°. Thus, the sensitivity of the apparatus was increased without basic changes. This method is especially suited for use with a ruby laser. Transl. by G.G.

N69-36114# Institut Franco-Allemand de Recherches, St. Louis (France).

THE ASTIGMATISM IN THE SCHLIEREN-OPTICAL ARRANGEMENT [L'ASTIGMATISME DANS LE MONTAGE STRIOSCOPIQUE]

F. Albe 11 Dec. 1968 14 p refs In FRENCH; GERMAN summary

(ISL-T-49/68) Avail: CFSTI

The aberration of the wave surface was calculated for the schlieren-optical arrangement at this facility and compared with the aberration of a sphere. It was found that the distance between the

light source and its image is the parameter that affects this aberration and permits its reduction. The maximum distance representing the tolerance limit for a correct image of the entry slit is calculated based on a principle of Rayleigh. Transl. by K.W.

N69-36144 Laboratorio de Acoustica e Sonica, Sao Paulo (Brazil).
SOUND AND ACCELERATION LEVEL OBSERVED IN PLASTIC INDUSTRY, ANALYZED IN OCTAVE BAND AND IN NARROW BAND, PRODUCED BY THE INSTALLED EQUIPMENT [MEDIDAS DE NIVEIS GLOBAIS E ANALISES EM FAIXAS DE OITAVAS E M FAIXA ESTREITA DO BARULHO E ACELERACAO OBSERVADO EM MAQUINARIO INSTALADO EM INDUSTRIA DE PLASTICOS]
L. X. Nepomuceno and F. Lucchesi 24 Jan. 1969 104 p In PORTUGUESE; ENGLISH summary
(TN-6901.359) Avail: CFSTI

Measurements of sound waves and noise acceleration levels produced by operating machinery in a plastics industrial plant are reported. The procedures and equipment used are described together with the specifications and results obtained with sound and vibration analysis in both octave and narrow band frequencies. The data derived were utilized to correlate the machinery use with sound and vibration levels in order to obtain a satisfactory maintenance factor. Author

N69-36197# Institut Franco-Allemand de Recherches, St. Louis (France).
CONTRIBUTION TO THE THEORETICAL STUDY OF SCHLIEREN SENSITIVITY [CONTRIBUTION A L'ETUDE THEORIQUE DE LA SENSIBILITE DE LA STRIOSCOPIE]
L. Oudin and Chr. Lavirotte 9 Dec. 1968 48 p refs In FRENCH; GERMAN summary
(ISL-T-58/68) Avail: CFSTI

In the schlieren method, intensities approximately proportional to the deflection of the light beam within the phase object are measured on the photographic plate. In this paper, mathematical expressions are established for the image of a Heaviside function in spatially incoherent monochromatic light. The object Heaviside function is produced by covering the light source by means of a schlieren edge. The schlieren sensitivity data were calculated and are presented in tables for various continuous backgrounds of the light and for various aperture diaphragms. It is found that the maximum sensitivity in analog to the square root of aperture area, with the round aperture having a small advantage over the square aperture within the range that was studied (mirror with constant curvature radius of 2 m, various round and square aperture diaphragms). If a given width of the schlieren slit is exceeded, the sensitivity develops hyperbolically and the diffraction effect can be neglected. Transl. by K.W.

N69-36244 Michigan Univ., Ann Arbor.
AN EXPERIMENTAL AND THEORETICAL ANALYSIS OF THE CONVECTED BALANCED ARC
Leland Malcolm Nicolai (Ph.D. Thesis) 1968 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-2365

The behavior of a direct current electric arc in a cross-flow and transverse magnetic field. The experimental part of the investigation was carried out on high current arcs (175 to 500 amperes) balanced by a magnetic field B in a supersonic airstream at Mach numbers M_∞ of 2.5, 3.0, and 3.5. The arc slanted in the airstream with the anode spot upstream of the cathode. The slant angle was close to the free stream Mach angle and increased slightly with increasing current. A reference station 1/3 the distance from the anode to the cathode was selected for all the measurements. The stream-wise d_S and transverse d_T dimensions were measured from photographs with d_T about 50 per cent larger than d_S. Both dimensions increased with current according to $d \approx \sqrt{I}$. Microdensitometer scans of the arc photographs showed the peak temperature well forward of the arc axis. Results from the numerical solution of the governing equations showed the same feature. The measured radiance distribution was three orders of magnitude larger than the calculated distribution. The measured and calculated radiance distributions had similar shapes, however, suggesting similar kinetic temperature distributions. The theoretical analysis was based upon a continuum fluid and the experimental observation that the convected balanced arc is impervious to the free stream. Dissert. Abstr.

N69-36324# Institut Franco-Allemand de Recherches, St. Louis (France).
SCHLIEREN METHOD. EFFECT OF A GAS CYLINDER ON THE FORM OF WAVE FRONT AND THE CALCULATION OF LIGHT DEFLECTION [STRIOSCOPIE. EFFECT D'UN CYLINDRE GAZEUS SUR LA FORME DU FRONT D'ONDE ET CALCUL DES DEVIATIONS]
L. Oudin and Chr. Lavirotte 24 Jan. 1969 45 p ref In FRENCH; GERMAN summary
(ISL-T-6/69) Avail: CFSTI

A computer simulation of a schlieren-optical arrangement is described in which the instrument data and a known phase objective were used as input values. The form of the wave front and the deflection of the light beams when passing through the objective are shown as curves, proceeding from the assumption that their path is not straight. The phase objective shows a cylindrical distribution of the refractive indexes. The purpose of the study is to determine under what conditions one refractive index will define the central are in the wake of a hypervelocity projectile and how that index differs from the one defining the area surrounding the core. Transl. by K.W.

N69-36386# Institut Franco-Allemand de Recherches, St. Louis (France).
DETERMINATION OF REFRACTIVE INDEX DISTRIBUTION FROM PHASE SHIFT OR DEFLECTION [RESTITUTION DE LA RERARATITION D'INDICE A PARTIR DU DE PHASAGE OU DE LA DEVIATION]
L. Oudin, A. Kalt, and M. Poulenard 29 Jan. 1969 31 p ref In FRENCH; GERMAN summary
(ISL-T-5/69) Avail: CFSTI

A basic level or cylindrical light wave transmits through a phased object whose fractionation index is of rotational symmetrical distribution [n = m(r)]. The diffraction of the light beams makes it possible to determine every continuing phase of the index distribution in the object up to one constant. The diffraction index distribution is completely solved when the function n(r) is constant and its value in the object's boundary is known. The discussed experiments are to be evaluated by schlieren photography. In the presented example, schlieren optics give diffractions attributable to two sequential beam transfers that do not exactly match. This effect is considered in the index distribution calculation. Transl. by G.G.

N69-36394# California Inst. of Tech., Pasadena. Antenna Lab.
THEORY OF ELECTRODYNAMICS OF MEDIA IN NON-INERTIAL FRAMES AND APPLICATIONS
Tse Chin Mo Apr. 1969 128 p refs
(Grant AF-AFOSR-1400-68)
(AD-688226; TR-48; AFOSR-69-1019TR) Avail: CFSTI CSCL 20/3

In the first half of the thesis a local electrodynamics of media in given non-inertial frames within Maxwell-Einstein classical field theory is constructed in terms of observable EM fields and co-moving local physical media parameters. Localization of tensors to observables is introduced and justified, and a relation is obtained connecting tensor transforms to instantaneous Lorentz transforms for observers in different frames. A constitutive tensor, explicitly expressed by the 4-velocity and the local properties in co-moving frame of a linear medium, is found for the first time. Also a Lagrangian formulation for both lossless and lossy media is constructed, and boundary conditions, local conservation laws, and energy momentum tensor are obtained. The second half concerns application to motions in SRT, such as uniform linear (hyperbolic) acceleration and steady rotation. For these local Maxwell equations in co-moving frames are obtained, and approximate solutions are found for special cases. Author (TAB)

N69-38492# Institut Franco-Allemand de Recherches, St. Louis (France).

RESEARCH ON OPTIMUM CONDITIONS FOR USING THE FOUCAULT METHOD FOR THE VISUALIZATION OF FLOW PHENOMENA AT LOW PRESSURE IN A FREE-FLIGHT TUNNEL [LA RECHERCHE DE MEILLEURES CONDITIONS D'EMPLOI DE LA METHODE DE FOUCAULT POUR LES VISUALISATIONS A BASSE PRESSION AU TUNNEL DE TIR]

H. Royer 14 Mar. 1968 23 p refs In FRENCH; GERMAN summary
(ISL-T-4/68) Avail: CFSTI

Theoratical and experimental studies are used to determine the necessary conditions for obtaining the most information during schlieren optical investigation of the evaluated object. Thus, the possibility is given to improve current instrumentation used for wind tunnels. Transl. by G.G.

N69-38721# Northwestern Univ., Evanston, Ill. Dept. of Physics.

ON THE ISING MODEL WITH LONG RANGE INTERACTION 2: CRITICAL REGION ANALYSIS

Colin J. Thompson (MIT, Cambridge), Arnold J. F. Siegert, and David J. Vezzetti (Ill. Univ., Chicago) 16 May 1969 46 p
(Contract N00014-67-A-0356; Grants NSF GP-7328; NSF GP-8734)
(AD-688203; TR-2) Avail: CFSTI CSCL 20/12

The high temperature expansion for the free energy in powers of gamma (the reciprocal of the range of interaction) developed in a previous paper is studied in the critical region. The results are in agreement with various model results and it is conjectured that the given condition is also a necessary and sufficient condition for the existence of a phase transition. TAB

N69-38848# Naval Ammunition Depot, Crane, Ind.

VISIBLE RADIATION FROM ILLUMINATING FLARE FLAMES

Bernard E. Douda (M.S. Thesis--Ind. Univ., Bloomington) May 1969 79 p refs
(AD-688769; RDTR-96) Avail: CFSTI CSCL 19/1

Spectra of flames from pyrotechnic flares containing magnesium plus nitrates of lithium, sodium, potassium, rubidium, cesium, strontium, or barium are presented to show emission in the visible and near-infrared regions. The strongest feature in each of the alkali metal spectra is the strong, broad resonance line continuum in the resonance region appropriate to each metal. Most of the light from a sodium flare originates from continuous emission composed of the resonance line continuum and the background continuum. In the alkali metal spectra, atomic lines (other than the sodium D lines) and molecular bands account for only a small amount of the luminous energy emitted from the flame. In contrast, hand emissions are the strongest feature of strontium and barium flame spectra. When alkali metals are present in high concentrations, the emission associated with the alkali metal resonance lines has a deep minimum of intensity at the resonance frequency with intensity maxima as much as 100A on either side of the line center frequency. As the pressure of the atmosphere surrounding the flame is reduced, there is a marked change in spectral distribution of the radiant energy and a reduction of the intensity of the resonance line continuum and the background continuum. Author (TAB)

N69-38905 Michigan Univ., Ann Arbor.

SELF-INTERACTION OF ACOUSTIC WAVES IN CADMIUM SULFIDE

John Holman Gibson (Ph.D. Thesis) 1968 150 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-2323

A study of the acoustoelectric self-interaction of a 30 Mc ultrasonic wave packet propagating in a cadmium sulfide single crystal is reported. This self-interaction results from the fact that the acoustic attentuation rate may be modified by imparting a drift velocity to the electrons, and such a drift velocity is in turn produced by the acoustoelectric current resulting from acoustic attenuation. The effect of the self-interaction may be computed by subetituting the acoustoelectric current for the drift current in the small-signal theory. This is done in order to compute the influence of the self-interaction on the detailed shape of the acoustoelectric current pulses generated as short acoustic wave packets traverse the crystal. These predicted pulses were compared directly with experimental results. Upon comparison it is seen that th observed effect of the self-interaction is larger than the computed effect, and the predictions are more accurate at high crystal resistivity than at low. This is in part explained as a failure of the calculation of account for the influence of the second harmonic component of the acoustoelectric current in the local attentuation rate. Dissert. Abstr.

N69-38974# Pratt and Whitney Aircraft, East Hartford, Conn.

ANALYTICAL AND EXPERIMENTAL STUDIES FOR PREDICTING NOISE ATTENUATION IN ACOUSTICALLY TREATED DUCTS FOR TURBOFAN ENGINES

Ernest Feder and Lee Wallace Dean, III Washington NASA Sep. 1969 112 p refs
(Contract NAS1-7129)
(NASA-CR-1373; PWA-3488) Avail: CFSTI CSCL 20A

Analytical and experimental studies were performed along with measuring acoustic properties of duct lining materials. The system developed for this program measured the impedance of acoustic materials in the presence of grazing airflow velocities from 0 to 700 fps. The specimens included perforated plates, resistive materials, and perforated plates with a resistive backing material. The rate of change of these acoustic properties was determined for each type of specimen, and it was noted that the resistance of the acoustic specimens increased and the reactance generally decreased with increasing flow velocity and sound pressure level. The analytical studies obtained solutions for sound wave propagation in terms of modes in a rectangular duct lined on parallel sides with identical acoustic treatments, and the noise attenuation in the duct was determined by means of linear theory from the pressure decay coefficients of the modes. The effect of changing distances between treatments from 2-1/2 to 20 inches was examined. Results indicate that maximum attenuation occurs at low frequencies. Comparison were made of the two methods with good agreements. Author

N69-37028*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHENOMENOLOGICAL THEORY OF LOUDNESS
Walton L. Howes Washington Sep. 1969 51 p refs
(NASA-TN-D-5422) Avail: CFSTI CSCL 20A

Alternative time- and frequency-domain equations are presented for predicting the loudness of a wide variety of statistically stationary and nonstationary sounds, either continuous or discontinuous. Zwislocki's theory of temporal summation and S. S. Stevens' psychoacoustic conversion law are incorporated in the present mathematical theory. Frequency domain formulas of Zepler and Harel for impulsive sonic booms and Jones for steady noise represent specializations of the present formulas. For sinusoidal inputs, modified Fletcher – Munson auditory response curves are predicted. For an impulsive input the measured response is also predicted. Author

N69-37168# Air Force Cambridge Research Labs., Bedford, Mass.
HARMONIC GENERATION OF MICROWAVE PHONONS
Paul H. Carr Feb. 1969 107 p refs *Its* Phys. Sci. Res. Papers No. 369
(AD-689395; AFCRL-69-0052) Avail: CFSTI CSCL 20/12

Harmonic generation due to the phonon-phonon interaction and harmonic generation in nonpiezoelectric dielectrics produced by the radiation pressure of a microwave electric field was investigated. Harmonic generation due to the phonon-phonon interaction was measured by detecting the 9-GHz second-harmonic component of acoustic waves, whose fundamental was generated by the piezoelectric effect in a 4.5-GHz reentrant cavity, and was treated theoretically by obtaining perturbation solutions for both the classical nonlinear wave equation and the quantum-mechanical phonon-phonon interaction in which two collinear phonons collide to create a third phonon. The third-order elastic coefficients c sub 111 and c sub 333 have been measured for quartz, sapphire, and MgO. The second harmonic of longitudinal waves in MgO was observed to be of the same magnitude as the fundamental for an acoustic power of 100 mW/sq cm (strain 0.000001). Harmonic generation due to radiation pressure was measured by detecting the 9-GHz acoustic waves harmonically generated at the end surface of a nonpiezoelectric rod placed in the electric field of a 4.5-GHz cavity. The radiation pressure of Maxwell - Faraday stress was computed from the measured value of the electric field and used to predict the acoustic power generated. A new perturbation method was developed for measuring this electric field, which is as large as 0.00001 V/cm. Author (TAB)

N69-37191# Houston Univ., Tex. Dept. of Physics.
THE ATTAINMENT OF ZERO MAGNETIC FIELD IN A SUPERCONDUCTING LEAD SHELL
Alvin F. Hildebrandt and D. D. Elleman (JPL) *In* Va. Univ. Phys. of Superconducting Devices 1967 6 p (See N69-37176 21-09)
(Contract NAS7-100)
Avail: CFSTI CSCL 20C

Static magnetic fields were derived from the Meissner effect in superconducting lead shell. Six separate experiments of the lead shell in a reduced field are described, and a thermoelectric effect due to strain and temperature gradients was quantitatively assessed. J.A.M.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N69-38005# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
PARTIAL RADIATIVE CAPTURE OF RESONANCE NEUTRONS [CAPTURE RADIATIVE PARTIELLE DES NEUTRONS DE RESONANCE]
Claude Samour (Ph.D. Thesis – Paris Univ., 28 Feb. 1968) Apr. 1969 247 p refs In FRENCH; ENGLISH summary
(CEA-R-3776) Avail: CFSTI

The radiative capture of resonance neutrons was studied near the Saclay linac between 0.5 and 700 eV with time-of-flight method and a Ge(Li) detector. Pt195 + n and W183 + n allow one to analyze the distribution of partial radiative widths and their eventual correlation and also the variation of $< \Gamma\gamma i >$ with $E\gamma$. The mean values of M1 and E1 transition intensities are compared in several tin isotopes. Interference effects, either between resonances or between direct capture and resonant capture are found in $^{195}Pt + n$, $^{197}Au + n$ and $^{59}Co + n$. The excited level schemes of a great deal of nuclei are obtained and compared with theoretical predictions. This study was completed by an analysis of thermal spectra. Author (ESRO)

N69-38006# University Coll., London (England). Dept. of Physics.
OSCILLATOR STRENGTHS IN COMPLEX ATOMS: APPLICATION TO NIV
H. Nussbaumer [1969] 23 p refs Sponsored by ESRO
Avail: CFSTI

NIV is responsible for some prominent features in Wolf Rayet stars. There is however a curious absence of λ 5820 $2p3p\ ^3P - 2p3d\ ^3P^o$. Neither has this line been found in the laboratory. This work was undertaken in view of explaining that absence but the methods employed and the corresponding computer program may be used for the calculation of oscillator strengths of any complex atom. It is based on a program for the calculation of atomic structure allowing for configuration interaction. It is found that in 16 out of the 34 lowest terms configuration interaction is considerable. The absence of NIV λ5820 may be explained as the effect of a very small branching ratio against the transition from $2p3d\ ^3P^o$ to $2p^2\ ^3P$. That the spectral feature around λ5810 in Wolf Rayet stars cannot be due to $2p3p\ ^3P - 2p3d\ ^3P^o$ is demonstrated by invoking the transition $2s4s\ ^3S - 2p3d\ ^3P^o$ which gives a line at λ7413. Author (ESRO)

N69-38051# Montpellier Univ. (France). Dept. de Physique Mathematique.
INELASTIC AND FINITE WIDTH EFFECTS FOR POSITRON ELECTRON YIELD 2 PIONS, 3 PIONS AND KAON ANTIKAON
F. M. Renard Jun. 1969 25 p refs
(PM/69/4) Avail: CFSTI

The Gounaris-Sakurai approximation was extended to the many-channel case. In the case of the ρ meson propagator (in particular for the pion form factor), the finite width factor was substantially modified by the $K\bar{K}$ and mostly by the $\pi\omega$ closed channels; it is explicitly given in terms of the $f_{K\bar{K}}$ and $f_{\rho\omega\pi}$ coupling constants. The propagator is essentially not modified by the width effects of the 3π and $K\bar{K}$ channels as Γ_ω is small. Important effects occur for the ψ meson as this resonance is close to the K^+K^- and $K^*\bar{K}^*$ thresholds; the factor a is decreased from 1 to 0.85 and the resonance shapes of the cross sections for e^+e^- to 3 and $K\bar{K}$ are deformed by an effect of 10%. Author

N69-38055 Illinois Univ., Urbana.
DIRECT-SEQUENTIAL ORDER-OF-EMISSION INTERFERENCE EFFECT
Victor G. Scotland (Ph.D. Thesis) 1968 157 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-1483

The reaction $^{9}Be(^{3}He,\alpha)^{8}Be^{*}\rightarrow\alpha+\alpha$ was studied at incident beam energies of 27.4 and 27.8 MeV. Two solid state detectors were mounted in the reaction plane and set at such angles that the peak corresponding to the $^{9}Be(^{3}He,\alpha)^{8}Be(E_{excit.} = 11.4$ MeV) and the peak due to $^{8}Be(E_{excit.} = 11.4$ MeV) $\rightarrow 2\alpha$, as seen in a given detector, were superimposed over a wide angular range. The results show that for $E_p = 27.8$ MeV, $\theta_1 = 77°$, $\theta_2 = 60°$ and for $E_p = 27.4$ MeV, $\theta_1 = 80°$, $\theta_2 = 59°$ there is order-of-emission destructive interference, where a peak due to the superimposition of the two closely spaced peaks is expected. Assuming no interference is present, the width of the 11.4 MeV level of $^{8}Be^{*}$ as deduced from the separation of the two peaks is less than 2.5 MeV, a value which is considerably smaller than the known width of 4.0 MeV. On the other hand, using coherent addition of two line shapes characterized by widths of 4.0 MeV, one can predict a dip between the two peaks that is in qualitative agreement with the experimental data. Dissert. Abstr.

N69-36056 California Univ., Los Angeles.
CROSSING EQUATIONS, KINEMATIC CONSTRAINTS AND THE REGGE MODEL OF ELASTIC SCATTERING
Alfred Arthur Actor, Jr. (Ph.D. Thesis) 1968 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-1099

Crossing equations that connect any elastic scattering channel with its crossed channel are, by assuming parity and time reversal invariance in the elastic channel, decomposed into four much simpler closed systems of equations. To achieve this, new amplitudes are defined which are certain linear combinations of the helicity amplitudes. In terms of the new amplitudes, elastic channel forward scattering constraints are of two distinct types. These constraints, on crossed channel amplitudes, are expressed for arbitrary spins of the elastic channel particles. The crossed channel amplitudes are Reggeized. One type of constraint is seen to require conspiracies among Regge trajectories, while the other does not. Two versions of the Regge model of elastic scattering are constructed. These explicitly satisfy both types of constraints for any spins. One version evades all conspirator constraints. The other is the simplest possible conspirator model. Dissert. Abstr.

N69-36057 Connecticut Univ., Storrs.
THEORY OF ANISOTROPY IN RADIOLUMINESCENCE
Myron Luntz (Ph.D. Thesis) 1968 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-2158

The interaction between energetic heavy ions of energy to mass ratio ranging from 1 – 10Mev/amu and the constituents of NaI(Tl) and CsI(Tl) single crystals is treated, for particle incidence along the crystal channels NaI < 100 >, NaI < 110 >, CsI < 111 > and CsI < 100 >, a prediction of the luminescent response to the channeled particles. An observed anisotropy is attributed qualitatively to the combined effect of channeling and the saturation of scintillation efficiency for high specific energy loss. It is assumed that channeled particles, due to their anomalously low rate of energy loss, tend not to saturate the scintillation efficiency and thus induce a brighter than normal response. An analytic expression for the specific energy loss of the best channeled particles is obtained. To this end, an existing electron-gas model is applied to a treatment of the excitation of valence electrons, and an additional term is constructed which accounts for core-electron excitation. Non-participating electrons are identified by application of an adiabaticity criterion and are excluded from all stopping power consideration. The particle trajectories are taken to lie directly along the channel axes. Dissert. Abstr.

N69-36060 University of Southern Calif., Los Angles.
DETERMINATION OF EXCITED STATE DIPOLE MOMENTS BY LINE SHAPE ANALYSIS OF ELECTRIC FIELD-INDUCED SPECTRA OR THE KILROY CAPER
David Alan Haner (Ph.D. Thesis) 1968 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-616

A theoretical development of the electric field-induced line shape is presented, based on Stark effect and transition probability for a symmetric top molecule to second order in the field. A resume of the Stark effects and transition probabilities for all possible transitions is included. Three methods for the approximate removal of slit effects from a spectrum are given, and the results of applying the finite difference method with a parameter search technique are presented. An experiment using formaldehyde to obtain field modulated and phase detected rotovibronic lines in the 3390 Å band is described. In addition, nitrogen spectra selectively excited in a helium afterglow were studied to understand details of the excitation processes. Distributions of population over the rotational and vibrational levels of the excited-electronic states were obtained by measuring relative intensities of the resulting transitions. Relative changes in population distributions were observed for a variety of experimental conditions designed to change concentrations of the energetic helium species relative to one another. Dissert. Abstr.

N69-36151 Daresbury Nuclear Physics Lab. (England).
BEAM INTENSITY MEASUREMENT Symposium Proceedings
V. W. Hatton, ed. and S. A. Lowndes, ed. 1968 315 p refs Symp. held at Daresbury, 22 – 26 Apr. 1968
(DNPL/R1) Copyright. Avail: Issuing Activity

Conference papers on accurate and reliable measurement and calibration of beam intensities are presented. The areas of investigation are Faraday cups and secondary emission monitors, quantameters, ionization chambers, and toroids and RF cavity monitors. For individual titles see N69-36152 through N69-36182.

N69-36153 Glasgow Univ. (Scotland). Kelvin Lab.
BEAM MONITORING FOR THE GLASGOW LINEAR ACCELERATOR
D. V. Land *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 20 – 30 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

A short description is given of the accelerator and beam handling installations at the University of Glasgow, and important characteristics of electron and positron beams are detailed. The inductive beam current and position monitoring systems, their performance and problems encountered in their design, and the performance of the television beam profile viewing system, are described. The views of other members of the laboratory concerning beam monitoring for particular classes of experiments are briefly presented. Author

N69-36155 Princeton-Pennsylvania Accelerator, Princetnn, N.J.
PRINCETON PENNSYLVANIA BEAM MEASUREMENT
J. L. Kirchgessner, C. L. Kang, and J. Hanness *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 36 – 42 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Operational details of the design and performance of the Princeton Pennsylvania Accelerator (PPA) complex are recorded. The accelerator is a rapid cycling (20 Hz) 3GeV proton synchrotron with the present intensity level of the beam at approximately 4×10^{10} protons per pulse or 0.8×10^{12} protons per second. Block diagrams of the internal beam induction electrodes, the electronic

system used with the tuned RF cavity, the ferrite-loaded, external proton beam cavity, the differential position ionization chamber, and the system for the extraction efficiency meter are discussed. M.H.E.

N69-36156 Argonne National Lab., Ill.
MEASUREMENT OF THE CIRCULATING PROTON INTENSITY OF THE ARGONNE ZGS
R. L. Martin *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 43–48 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Calibration procedures for the circulating beam of the zero gradient synchrotron (ZGS) at Argonne are recorded. Detection of the charge on an electrode in the ring is the basic approach, and calibration of the electrode and the aperture of the shield are described prior to initial operation, in full scale models, and as the detection circuitry was modified for simplicity and increased reliability. Diagrams of the ZGS Q-electrode, the circuitry used for electrode calibrations, all electronic modifications, the slow Q-detection circuitry, and a calibration curve of the slow Q-system accompany the discussion. Another criteria for the assessment of these calibrations, that of pion production and extraction efficiency measurements, substantiates confidence in the Argonne methods for the absolute calibration of the synchrotron circulating intensity. M.H.E.

N69-36157 National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.
DIAGNOSTIC EQUIPMENT IN HIGH ENERGY BEAM LINES
R. L. Redgrave *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 49–57 (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

The present arrangement of the proton beam line layout at the Rutherford Laboratory is shown in map form and described, system by system. Construction details of the ionization chamber and its mobility in relation to the beam line, and a block diagram of the ion chamber system are recorded; similarly, the secondary emission chambers and the toroid are described. Actual beam profile measurements are given in plots of protons per pulse versus chamber measurement. Oscilloscope tracings of the spill from Nimrod are also included. M.H.E.

N69-36158 European Organization for Nuclear Research, Geneva (Switzerland).
BEAM INTENSITY MONITORING AT THE CERN PROTON SYNCHROTRON
V. Agoritsas, S. Battisti, and C. D. Johnson *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 58–67 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Beam intensity monitoring at the CERN proton synchrotron is accomplished by the following instrumentation systems: scintillation screens used with TV systems, fast beam current transformers, secondary emission chambers, target monitors, nuclear emulsions, insulated targets or plates, and ionization chambers. Each type is matched to the control and measurement of some characteristic of the CPS internal and external proton beams which are of moderate to high intensity. New techniques for beam loss measurement such as emitted charge collection on approximately 1 mm thick plates from insulated targets are briefly described. Circuitry chains relaying electronic charges produced by proton losses which display loss information in the form of histograms are briefly discussed, as are target monitors and current transformers for fast, fast–slow, and slow ejection. M.H.E.

N69-36159 European Organization for Nuclear Research, Geneva (Switzerland).
NEUTRINO BEAM MONITORING
H. Wachsmuth *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 68–74 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Nuterino beams are produced by the decay in flight of accelerator produced pions and kaons. Because of the small signals from the beams, an indirect method is needed to determine and monitor the neutrino spectrum. The purpose of the system is to guarantee the largest possible number of photographed neutrino events relative to the ejected protons, and to provide information necessary for the analysis of the experiment and the spectrum of the neutrino. To achieve the highest intensities the following rules were applied: (1) to use the maximum of meson production in the forward direction by extracting the proton beam onto an external target; (2) to direct the mesons toward the neutrino detector by means of huge axial symmetric magnetic fields (magnetic horns or reflectors); (3) to optimize the drift space with respect to the probabilities for mesons to decay and for neutrinos to hit the detector; and (4) to match the neutrino filter thickness to the maximum muon momentum which has to be absorbed. The accuracy of this method of nuterino production and monitering is still being studied. Author

N69-36160 Stanford Linear Accelerator Center, Calif.
A HIGH-PRECISION FARADAY CUP AND QUANTAMETER FOR SLAC
D. Yount *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 75–96 refs Supported by AEC (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

This paper describes more recent test data obtained with other monitors which includes a secondary emission monitor, a calorimeter, and a toroid. Comparisons of beam monitor responses for positrons and electrons are made. The new data are generally consistent with those published earlier and support the previous estimate of absolute Faraday cup efficiency at energies from a few hundred MeV up to 15 GeV. Author

N69-36161 Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire.
STUDIES FOR A HIGH POWER FARADAY CUP
D. B. Isabelle and M. Jeanjean *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 97–98 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

The cup design depends on the energy of the incident electrons. For low energy electrons, the beam is spread by multiple scattering, and for high energy electrons the beam is spread by an electromagnetic lens. To cool the process on the cascade block water is used. This creates several problems because water cooling acts as a battery in the absence of electron beams. Other problems include the stoppage of low energy electrons in the water, and the radiolysis of the water implies the process must be leak-free. The high power beam is being tested to see if the cup will accept it over short periods. Some temperature measurements are performed. E.H.W.

N69-36162 Daresbury Nuclear Physics Lab. (England).
THE DARESBURY FARADAY CUP
V. W. Hatton *In its* Beam Intensity Meas. 1968 p 99–104 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

A design of the Faraday cup based on Monte Carlo calculations is described. The cup has a curious asymmetry which includes only

the magnetic field from the magnets at the cup entrance. This results in an increased current with the beam on one side and a decreased current on the other. Tests performed used only the small beams and water was not added during the tests. Results obtained so far include bias curves and radial aperture measurements. Author

N69-36163 Cambridge Electron Accelerator, Mass.
A COMPARISON OF CEA AND SLAC FARADAY CUPS BY MEANS OF A SECONDARY EMISSION MONITOR
G. F. Dell and M. Fotino *In* Daresbury Nucl. Phys. Labs. Beam Intensity Meas. 1968 p 105–116 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Comparison data for the two cups are based on long and short runs of the beams. For the SLAC a 24-hour observation was made, and for the CEA a period in excess of one year. Differences occurred in the shielding geometries of the two cups. The CEA cup is shielded in a hut, the SLAC cup is unshielded. It is assumed that this accounts for the small difference, .4% at 3 GeV, encountered in the measurement of the beams. Results indicate the energy dependencies are the same. No attempt was made for absolute calibration. E.H.W.

N69-36164 European Organization for Nuclear Research, Geneva (Switzerland).
SECONDARY EMISSION CHAMBERS FOR MONITORING THE CPS EJECTED BEAMS
V. Agoritsas *In* Daresbury Nucl. Phys. Labs. Beam Intensity Meas. 1968 p 117–151 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

An attempt to monitor the high intensity- high energy proton beam was made in the CERN proton synchrotron. To aid in these studies, emission chambers were built using foils to aid in helping the charged particles reach the surface to be ejected. Calibrations were based on cross sections in the proton–protron scattering, and the current transformer. Efficiency tests show satisfactory results. E.H.W.

N69-36166 Tokyo Univ. (Japan). Inst. for Nuclear Study.
INTENSITY MEASUREMENTS OF EXTRACTED ELECTRON BEAM FROM THE TOKYO 1.3 GeV ELECTRON SYNCHROTRON AND CALIBRATION OF A SECONDARY EMISSION MONITOR
H. Sasaki *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 159–165 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

A calibration monitor was constructed to measure the intensity of an extracted electron beam. The calibration of the monitor was performed with a quantameter and a thick walled ionization chamber. The measurements were carried out in two steps. In one method, the extracted beam was exposed to a beam transport system composed of deflection and quadrupole magnets. After emerging it was measured with the quantameter. In the second method, the electon beam was converted to gamma rays and diverted into a beam stopper, then measured by ionization chambers. Results indicate satisfactory measurements. E.H.W.

N69-36167 Stanford Linear Accelerator Center, Calif.
METHOD OF STABILIZING HIGH CURRENT SECONDARY EMISSION MONITORS
E. L. Garwin and N. Dean *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 166–168 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

Various attempts were made to fabricate secondary emission monitors (SEM) which exhibit stability in electron beams with current densities in the range 1 to 40 μ A/cm^2. The efficiency increased with transmitted charge in clean SEM. Vacuum evaporated silver was used for a foil coating of SEM to achieve stability. J.A.M.

N69-36169 Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
COMMENTS ON QUANTAMETER CALIBRATION AND PERFORMANCE AT DESY
E. Raquet *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas. 1968 p 182–186 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

A quantameter with a gas mixture of 95% argon and 5% carbon dioxide was used for a satisfactory linear response. The intensity of the collimated gamma beams did not exceed 1–3 $\times$ 10^8 effective quanta per pulse. In this intensity range, quantameter response with argon and carbon dioxide was fairly independent of the beam intensity. A secondary emission monitor was used as a reference during the tests. Leakage of gas volume caused a decrease in long term stability of the quantameter. Improvements in the shielding of the experiments are being tested. J.A.M.

N69-36177 Academy of Sciences (USSR), Moscow. P. N. Lebedev Physical Inst.
ON THE SENSITIVITY OF THE THICK-WALLED ION-CHAMBER AT BREMSSTRAHLUNG ENERGIES 4–27 MEV
G. M. Gurevich, B. N. Ponomarev, and G. V. Solodukhov *In* Daresbury Nucl. Phys. Lab. Beam Intensity Meas., 1968 p 238–243 refs (See N69-36151 21-24)
Copyright. Avail: Issuing Activity

The results of experimental and calculated sensitivity of thick walled aluminum ion chambers are presented, and the optimum geometrical parameters are discussed. The construction of the aluminum chamber, and the sensitivity measurement techniques are described. Graphs summarizing the results are included. F.O.S.

N69-36185 Princeton Univ., N.J.
SOFT PION REACTIONS, WITH APPLICATION TO ANTIPROTON PROTON ANNIHILATION
Rein Aarne Uritam (Ph.D. Thesis) 1968 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-2566

Current algebra and PCAC are applied to calculate the differential rate for the process $pp \rightarrow K^+K^-\pi^+\pi^-$, normalized to the $pp \rightarrow K^+K^-$ rate, in the soft pion limit for annihilation in flight at vanishing momentum. The calculation proceeds within the framework of soft pion methods; in this approach a relation is derived for an amplitude to low order in all components of the pion momentum. It is then asserted that this form of the amplitude is valid also for low pion momenta in the physical region. In the beginning, the matrix element of the time-ordered product of two axial currents is used. Using current algebra and PCAC a relation between the amplitude for $i \rightarrow f + 2\pi$ and two other terms is derived. These methods are then applied to pp annihilation, and the amplitude for $pp \rightarrow K^+K^-\pi^+\pi^-$ is calculated. Comparison with experiment involves two considerations. To obtain the branching ratio one must integrate over all values of pion momenta, whereas the theory applies to soft pions. There is not sufficient data to display the experimental spectrum in the five kinematic variables. Dissert. Abstr.

N69-36217# Laboratoire de Physique Theorique et des Hautes Energies, Paris (France).
CHARGE EXCHANGE SCATTERING AND REGGE CUTS
A. Krzywicki and J. Tran Thanh Van 4 Jul. 1969 14 p refs
(LPTHE-TH-69/45) Avail: CFSTI

We drive a few asymptotic relations between observable quantities for the charge exchange scattering on nucleons of mesons belonging to the pseudoscalar octet. The Regge cuts are assumed to be present and to have some very general properties. Our relations are well satisfied by the present experimental data. A prediction of the polarization in $\bar{K}^- p \rightarrow \bar{K}^0 n$ is made. Author

N69-36230*# Techtran Corp., Glen Burnie, Md.
GENERAL CONSIDERATIONS CONCERNING METASTABLE SPECIES [CONSIDERATIONS GENERALES SUR LES METASTABLES]
Guy Watel Washington NASA Sep. 1969 34 p refs Transl. into ENGLISH from French Report
(Contract NASw-1695)
(NASA-TT-F-12353) Avail: CFSTI CSCL 20H

The metastable species are atoms, molecules, or ions in excited states whose lifetimes are sufficiently long for their return to ground states, under laboratory conditions, by the action of an outside phenomenon (electric or magnetic field, collision with other particles or the walls). This literature survey concerns the metastable atoms which were most studied up to now: helium, neon, hydrogen mercury, argon, and krypton. Author

N69-36236 Illinois Univ., Urbana.
AN UPPER LIMIT ON THE DECAY RATE OF K SUB L YIELDS POSITIVE PION PLUS NEGATIVE PION PLUS GAMMA
Roy Cannon Thatcher (Ph.D. Thesis) 1968 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-1467

In the film from a spark chamber experiment on K^0_L decays performed in the 28° beam line of the ZGS, a search for the decay mode $K^0_L \rightarrow \pi^+\pi^-\gamma$ was made. The charged decay products were momentum analyzed in a magnet and identified in a set of range-shower chambers on the basis of their behavior there. The position of the gamma ray conversion point in these chambers was compared with the position predicted on the hypothesis of $K^0_L \rightarrow \pi^+\pi^-\gamma$. The $K_{\pi 3}$ provided almost the sole background as well as the normalization of rate measurement. In 962 events with good gamma showers, one event fitted the $\pi\pi\gamma$ hypothesis within the special resolution. However, the expected background was one event. This result corresponds to an upper limit on the decay rate $R(K^0_L \rightarrow \pi^+\pi^-\gamma) \leq 7.5 \times 10^3$ sec^{-1} at a confidence level of 90%. The result is compared with the predictions of various theoretical models. The possible connections to other decay processes ($K^\pm \rightarrow \pi^\pm\pi^0\gamma$, $K^0_L \rightarrow \pi^0\pi^0\gamma$, $K^0_S \rightarrow \pi^+\pi^-\gamma$) and the feasibilities of CP invariance tests are discussed. Dissert. Abstr.

N69-36240 Princeton Univ., N.J.
ISOTOPIC EXCHANGE REACTIONS INDUCED BY ALPHA PARTICLES IN HYDROGEN AND IN NITROGEN GASES
John Arthur Mahoney (Ph.D. Thesis) 1968 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-2760

The steady-state treatment of radiolytic chain reactions gives rise to a nonlinear differential equation, if there is a competition between second-order volume recombination and first-order wall termination. The equation was solved analytically for several limiting cases and numerically for spherical geometry. For many situations of experimental interest and particularly ones involving short chains, the numerical solution indicates that the reaction yield may be remarkably insensitive to either dose rate or pressure. An experimental study of the $H_2 + D_2 \rightarrow 2HD$ reaction induced by alpha particles apparently represents the first systematic investigation of the pressure dependence of the reaction yield. 2.75% xenon was added to suppress ion chain carriers and permitted isolation of the atom-molecule chain reaction. The results were in excellent agreement with the predictions of the solution of the diffusion equation and permitted a determination of the efficiency of radiolytic production of hydrogen atoms. Dissert. Abstr.

N69-36242 Texas Christian Univ., Fort Worth.
A MOLECULAR ORBITAL AND ESR STUDY OF NITRO-SUBSTITUTED ANION PION-RADICALS
Jesse Wallace Rogers (Ph.D. Thesis) 1968 190 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-749

Intramolecular and intermolecular rate processes in nitro substituted π-anion radicals were studied to improve and test a semi-empirical quantum mechanical theory. Spin densities and ESR hyperfine coupling constants of six nitro-substituted radicals were calculated using Huckel molecular orbital theory. This simple theory yielded a good correlation between the calculated and experimental values. However, it was found that the correlation was poorest for meta-substituted radicals and radicals with strong electron releasing para substituents. The self-consistent spin densities were in very good agreement with the experimental values. Visible transition energies calculated from the self-consistent eigenvalues were found to be in good agreement with visible spectra of the radicals. The ESR spectra of the 2-trifluoromethylnitrobenzene and 3-trifluoromethyl-4-nitrophenol anion radicals were found to exhibit extreme linewidth alternation. This result was successfully explained in terms of the Frenkel theory of linewidths. Electrolysis of 2-trifluoromethylnitrobenzene and 2,2'-dinitrobiphenyl at potentials greater than their second d.c. polarographic E1/2 produces paramagnetic species yielding ESR spectra not consistent with the structure of the original molecule. Certain aspects of the reduction process have been discussed and general mechanisms are postulated. Dissert. Abstr.

N69-36286*# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
RESEARCH INTO ADVANCED CONCEPTS OF MICROWAVE POWER AMPLIFICATION AND GENERATION UTILIZING LINEAR BEAM DEVICES Semiannual Status Report
P. R. Mc Isaac Jul. 1969 22 p refs
(Grant NGL-33-010-047)
(NASA-CR-105636) Avail: CFSTI CSCL 20H

This is an interim report which summarizes work during the past six months on a theoretical study of some aspects of the interaction between a drifting stream of electrons with transverse cyclotron motions and an electromagnetic field. Particular emphasis is given to the possible generation and amplification of millimeter waves. The report includes a discussion of the use of a digital computer to obtain start oscillation conditions for a spiraling filamentary electron beam in a cavity for a range of beam and cavity parameters. The report also includes an extension of the previous coupled mode theory to cover the interaction of a spiraling hollow electron beam with a square waveguide. Finally the initiation of a study on the consequences of symmetry on the interaction between an electron beam and a waveguide is mentioned. Author

N69-36280# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
PADE APPROXIMANTS FOR A YUKAWA POTENTIAL
S. Caser, C. Piquet, and J. L. Vermeulen Jun. 1969 22 p refs
(LPTHE-TH-69/42) Avail: CFSTI

The method of Padé approximants is worked out numerically for the case of a Yukawa potential to find bound states and resonances. The calculation is performed to the sixth order of the perturbation series. An interesting result about the unitarity properties of nondiagonal approximants is proved. Some insight can be obtained in the way this method works in relativistic field theory, especially in connection with left-hand singularities. Author

N69-36291*# Techtran Corp., Glen Burnie, Md.
X-RAY EMISSION FROM THE SOLAR CORONA
I. L. Beygman et al [1969] 22 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Fiz. Inst. im P. N. Lebedeva (Moscow), preprint 104, 1967 *Its* No. 15
(Contract NAS5-14826)
(NASA-CR-105625) Avail: CFSTI CSCL 20H

A number of new experimental data have recently become available on the spectrum of the solar corona in the X-ray region (1–30 Å). In this paper the spectrum is theoretically calculated with a number of refinements compared to previous computations. Specifically, dielectronic recombination and photorecombination on all levels were taken into consideration in calculating the ionization equilibrium. A computer was used for determining the effective cross sections of excitation, ionization, dielectronic recombination and photorecombination necessary for calculating population intensities. Author

N69-36253 European Organization for Nuclear Research, Geneva (Switzerland).
LOSS OF PROTONS BY NUCLEAR INTERACTIONS IN VARIOUS MATERIALS
D. F. Measday and C. Richard-Serre 25 Jun. 1969 65 p refs
(CERN-69-17) Copyright. Avail: Issuing Activity

The nuclear interactions which a proton undergoes passing through a material is studied by measuring the kinetic energy in stopping the proton in some materials such as silicon, or the energy loss by stopping, or reduction in other materials such as aluminum. It is shown that in these measurements for total-energy counters only inelastic interactions are important as the energy transfer for elastic collision is small. However, for range measurements the elastically scattered protons may be lost due to the geometry of the counter, and correction factors must be determined for each individual system. Results are tabulated for nuclear interactions of protons at different energies in various materials. F.O.S.

N69-36296# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
P-WAVE NONLEPTONIC HYPERON DECAYS AND URBARYON REARRANGEMENT
Mitsuaki Katsuya and Akihiro Murayama (Hokkaido Univ.) Jun. 1969 8 p refs
(RIFP-89) Avail: CFSTI

Quartent models are presented which show the main properties of the parity conserving P-wave. The modal shows that the nonleptonic hyperon decays are derived from two urberyon transitions with strong pion emissions, and from the weak two body interaction on the different urbaryons. Results indicate good agreement with experimental data. Author

N69-36298# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
MULTIPLE PHOTOIONIZATION OF XENON
R. B. Cairns, Halstead Harrison, and Richard I. Schoen Apr. 1969 30 p refs
(DI-82-0865) Avail: CFSTI

The photoionization cross sections for the production of Xe^+, Xe^{++}, and Xe^{+++}, have been measured in the energy range 28 to 83 eV. At energies between the thresholds for Xe^{++} production, 33.3 eV, and 4d-electron removal, 67.55 eV, and Xe^{++} cross section reaches about one-third of the total cross section. This cannot be accounted for by an independent electron model in terms of an electron shake-off process. At energies greater than 67.55 eV both the Xe^+ and Xe^{++} cross sections increase; here the singly charged ion should be accompanied by fluorescence and the doubly charged ion can result from a simple Auger process. The triple ionization is attributed to a process which involves first the removal of a 4d-electron and then an Auger event in which two electrons are emitted simultaneously. Author

N69-36306# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.
ON THE ORIGINS OF GALAXIES
R. Omnes Jul. 1969 6 p refs
(LPTHE-TH-69/49) Avail: CFSTI

Using a recently proposed model for matter-antimatter separation in the black-body radiation, we describe the evolution of the condensations of matter and antimatter in the Lemaître–Gamow universe. It is found that the condensations, initially 10^{-5} cm in size and having the nuclear density, lose much matter by annihilation during the hadronic and leptonic eras. During the radiation era, effects due to radiation pressure provoke a very efficient coalescence mechanism for the condensations which end up with the size and mass of a galaxy. Quasar formation is explained in the same way. Author

N69-36307# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.
THE EFFECT OF ANNIHILATION ON MATTER-ANTIMATTER SEPARATION
R. Omnes Jul. 1969 4 p refs
(LPTHE-TH-69/48) Avail: CFSTI

The effect of the annihilation of nucleons-antinucleons upon the process of matter-antimatter separation in the black-body radiation is considered. It is shown to be negligible if annihilation is correctly described by the statistical model. Author

N69-36310*# Missouri Univ., Kansas City. Dept. of Physics.
DEVELOPMENT OF FIELD IONIZATION FOR THE IMPROVEMENT OF MASS SPECTROMETRY Interim Scientific Report, 25 Mar. 1968–25 Mar. 1969
Paul J. Bryant and James M. Phillips 25 Mar. 1969 58 p refs
(Contract NAS12-646)
(NASA-CR-86223) Avail: CFSTI CSCL 20H

Described is the development of an efficient field ionization ion source and quadruple focusing system for the production of ions for mass spectrometry. A new carbon filament ionizer, designed and utilized on this program, has increased ion yield by two orders of magnitude. The new ionizer, coupled with an ion lens system designed for focusing and retarding the high energy field ions was successfully used as an ion source for a commercial quadruple mass spectrometer. The high ion yield obtained with the new type field ion sources, and the preliminary results with the mass spectrometer show the feasibility of practical applications. Ion yields were also computed from the transmission probabilities for an electron to pass through a molecular potential barrier. Author

N69-36337 European Organization for Nuclear Research, Geneva (Switzerland).
TRANSVERSE OSCILLATIONS OF A RELATIVISTIC PARTICLE BEAM IN A LAMINATED VACUUM CHAMBER
B. Zotter 9 Jun. 1969 45 p refs
(CERN-69-15) Copyright. Avail: Issuing Activity

Coherent transverse oscillations of relativistic particle beams may limit the number of particles that can be contained in accelerators and storage rings. In order to calculate the limit of stability one needs to know the electric and magnetic fields caused by the oscillating beam. These fields exert an electromagnetic force on the beam particles, which may be expressed by the dispersion relation coefficients U and V for the in-phase and out-of-phase components. While the in-phase component only shifts the betatron frequency, which may cause problems if resonances are crossed, the out-of-phase component will always give rise to instability in a monochromatic beam. The instability may be suppressed by a proper amount of energy and/or amplitude spread. This report discusses the dispersion relation coefficients for vacuum chamber walls consisting of several layers of material. A method is described which allows the calculation of U and V for a cylindrical beam surrounded by an arbitrary number of concentric layers, each layer being characterized only by three material constants: permeability, permittivity, and conductivity. The dispersion relation coefficients are evaluated numerically, and analytic expressions are found in the long wavelength limit for not too complicated wall configurations. Author

N69-36340# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ON THE BUILDING OF DUAL DIAGRAMS FROM UNITARITY
D. Amati, C. Bouchiat, and J. L. Gervais Jul. 1969 14 p refs
(LPTHE-TH-69/44) Avail: CFSTI

In an attempt to construct the hadron theory, the operation of multipartical Veneziano amplitudes to compute one loop dual diagrams from unitarity are discussed. Formulas and rules are set up in order to simplify the mathematical aspects. Results are workable, but modifications are needed. These modifications break the loop structure, and change some of the asymptotic properties of the amplitudes. Modification also causes more degeneracy. E.H.W.

N69-36344# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
K SUB L4 FORM FACTORS AND THE BREAKING OF CHIRAL SYMMETRY
M. K. Gaillard [1969] 25 p refs
(LPTHE-TH-69/40) Avail: CFSTI

K_{l4} form factors are studied under the assumption that chiral $SU_3 \otimes SU_3$ is broken by a term in the Hamiltonian which transforms according to the representation $(3,\bar{3})+(\bar{3},3)$. If the symmetry breaking is not such that an approximate $SU_2 \otimes SU_2$ invariance is retained, soft pion predictions obtained from matrix elements of currents differ from those obtained using matrix elements of the divergences. It is argued that in this case the soft pion limits of the divergence matrix elements give a better approximation to the physical amplitudes. Deviations from standard current algebra predictions in K_{l4} decay can then be related to deviations in K_{l3} decay (i.e. a large ξ-value). If ξ is large and negative ($\xi \approx -0.5$), K_{l4} decay rates are predicted to be considerably higher than those found with the standard soft pion techniques. Author

N69-36386# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
GROUP THEORETICAL ANALYSIS OF NUCLEAR STATES IN SOME j EQUALS 3/2 SHELLS
P. Camiz (Rome Univ.) and U. Cattani 30 Apr. 1969 48 p refs Submitted for publication
(ISS-69/17) Avail: CFSTI

The energy levels of nuclei in the shells $1p_{3/2}$, $1d_{3/2}$ and $2p_{3/2}$ are described by a group-theoretical mass formula deduced from the hypothesis of pure (j)^n configurations in the seniority scheme. The residual interaction between nucleons is decomposed into the pairing term (J=0, T=1), the isopairing term (J=odd, T=0) and a J $\neq$0 T=1 term; Coulomb interaction between protons is accounted for in a schematic way. The corresponding coupling constants, together with single particle energies, are treated as free parameters to be adjusted by a least-square fit to experimental data. Deviations between experimental and calculated energies are analyzed in order to test the validity of the proposed symmetry scheme in the three shells considered, and to discuss its possible improvements. Author

N69-36409# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
RESPONSE OF COBALT NEUTRON FLUX DETECTORS
J. A. Sovka Jun. 1969 37 p refs
(AECL-3368) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $1.00

Self-powered neutron detectors are being used to measure and control the flux in research and power reactors. For monitoring, the detector current due to β-decay of short-lived radioisotopes, e.g., Rh^{104} (42 s) and V^{52} (3.76 m), provides adequate response time. For controlling rapid flux transients faster detector response is required for which the prompt-response cobalt detectors were developed. However, the neutron activation products Co^{60} (5.27 y) and Co^{61} (99 m) contribute a background signal that increases with detector irradiation. The resulting reduction of the prompt signal-to-background ratio limits the useful life of cobalt detectors. The results of a theoretical investigation of their response through a study of the prompt and background signals as a function of irradiation time at different fluxes are described. Author

N69-36445# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
NONLEPTONIC HYPERON DECAYS AND BARYON BETA-DECAYS BASED ON THE QUARTET MODEL
Akihiro Murayama Jun. 1969 38 p refs
(RIFP-88) Avail: CFSTI

The correspondence between the phenomenological laws for the nonleptonic hyperon decays and the quartet model is investigated. It is shown that the S-waves decays can be explained by the single-urbaryon transition with the derivative type coupling, while the P-wave decays can be explained by the two-urbaryon transition. The quartet model is applied further to the baryon β-decays and it proves to succeed in describing the G_A/G_V-ratio of the neutron β-decay and the F/D-ratio of the axial-vector coupling in a compatible way with the non-leptonic hyperon decays. Author

N69-36450 European Organization for Nuclear Research, Geneva (Switzerland).
MULTIPLE COULOMB DIFFUSION OF HIGH ENERGY PARTICLES AT SMALL ANGLES IN LIMITED MEDIA [SUR LA DIFFUSION MULTIPLE COULOMBIENNE AUX PETITS ANGLES DES PARTICULES DE HAUTE ENERGIE EN MILLIEN LIMITE. APPLICATION]
Alain Durand 13 May 1969 138 p refs In FRENCH
(CERN-69-10) Copyright. Avail: Issuing Activity

Calculations are given for the diffusion trajectory of a particle traversing solid matter of a given thickness, where the position and angle of entry and the type of particle are known with measurable

energy loss and the effects of a magnetic field being significant parameters. Limited media diffusion is first analyzed by sectioning the diffusion space by N parallel bars, positioning the diffusion trajectory distributions on the bars by an integral of the factor ψ. An integration method is described for ψ in the space of N which allows the use of large-numbered bars (up to N=40) and is applicable to the case of diffusion on a plane or at right angles. In the second method, distribution functions of diffusion particles having similar properties are solutions of a double integral equation. Applications are demonstrated for angular and spatial distributions of pi-mesons of p=450 MeV/c diffusing through aluminum and iron, and for particles arriving at normal incidence on the edge of a flat plate. Additionally, the rejection rate of a multilayered separator was calculated by the pi-meson trajectory and its diffusion through the layers; computer analysis of experimental data correlated well with mathematical prediction. Transl. by M.H.E.

N69-36510*# Techtran Corp., Glen Burnie, Md.
DEVELOPMENT OF THE THEORY OF SYNCHROTRON RADIATION AND ITS REABSORPTION
V. L. Ginzburg et al [1969] 81 p Transl. into ENGLISH from Ann. Rev. Astronomy Astrophys. v. 7, 1969
(Contract NAS5-14826)
(NASA-CR-105607) Avail: CFSTI CSCL 20H

An elementary qualitative analysis of synchrotron radiation in case of noncircular particle movement is presented, and radiation of particle systems as well as the movement of individual particles at an arbitrary angle to a magentic field are covered. The investigation of reabsorption of synchrotron radiation by ultrarelativistic particles deals with the transfer equation for the tensor $I_{\alpha\beta}$, the Einstein coefficient method for polarized radiation, reabsorption in a vacuum, and reabsorption in the presence of a cold plasma. In addition, problems related to the theory of synchrotron radiation are considered, including radiation of sources moving at relativistic velocities, proton radiation, magnetic field changes due to energy losses of particles moving in the field, and mechanisms of cosmic radiation. K.W.

N69-36529# New York Univ., N.Y. Radiation and Solid State Lab.
MECHANISMS OF ENERGY TRANSFER IN DIELECTRICS Semiannual Report, 31 Dec. 1968–31 Jul. 1969
Werner Brandt Fort Monmouth, N.J. ECOM Apr. 1969 32 p refs
(Contract DA-28-043-AMC-01999(E))
(AD-688179; ECOM-01999-5) Avail: CFSTI CSCL 20/12

The processes pertinent to the relaxation of electrons at energies below internal ionization energy of a dielectric are studied. The probe used is the positron through its annihilation characteristics. A model is presented which relates the amount of positronium formed in a substance containing small concentrations of impurities with a lower ionization potential than the pure substance to the scattering and energy loss cross sections for positrons and electrons at energies below the lowest electronic excitation level of the pure substance. The positron annihilation spectra in polyethylenes and polytetrafluorethylenes of differing crystallinities subject to applied electric fields have been measured as part of our program of obtaining data from which the cross sections determining the transient electronic response of a dielectric to ionizing radiation can be determined. Positron annihilation is also being developed as a probe for investigating the changes in defect concentration in alkali halides which are produced by X-ray irradiation. Author (TAB)

N69-36538# Stanford Univ., Calif. High Energy Physics Lab.
REPORT ON THE PERFORMANCE OF THE SUPERCONDUCTING INJECTOR FOR THE STANFORD LINEAR ACCELERATOR
E. Jones, M. S. McAshan, and L. R. Suelzle Mar. 1969 16 p refs Presented at Particle Acc. Conf., Washington, D.C., Mar. 1969
(Contract Nonr-225(67))
(AD-690763; HEPL-598) Avail: CFSTI CSCL 20/7

The report describes some recent experiments performed with a prototype of the injector section eventually to be used in conjunction with the superconducting linear accelerator at Stanford University. Author (TAB)

N69-36543# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.
THE FEROTH PLACZEK MOMENT AND THE EFFECTIVE n-PHONON CROSS SECTION [DAS NULLTE PLACZEK-MOMENT UND DER N-PHONON-WIRKUNGSQUERSCHNITT]
O. J. Eder Apr. 1969 18 p refs In GERMAN
(SGAE-PH-82/1969) Avail: CFSTI

Use is made of the zero Placzek moment and the phonon expansion of the double differential scattering cross section for thermal neutrons scattered by a polycrystalline solid or a single crystal in order to calculate the contribution of the n-phonon term to the scattering intensity. This procedure can be extended to the case of liquids and anharmonic effects via a quasi-phonon expansion. Author

N69-36695# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.
THE PROTON RECOIL SPECTRUM OF THERMAL NEUTRONS DECAYING IN VACUUM
Otto Nachtmann (CERN–Geneva) and Helmut Paul 1969 17 p refs
(Contract AF 61(052)-857)
(SGAE-PH-84/1969) Avail: CFSTI

The decay of neutrons in an evacuated tangential reactor beam tube is considered. Due to the thermal motion of the decaying neutrons, the proton recoil spectrum in the laboratory system (z-axis parallel to the beam tube) differs from that in the c.m. system. This difference is calculated for a point at the beam tube exit, and expressed in terms of the average q_z and of the variance of the z-component of neutron momentum. An activation method for measuring the neutron current density $\mathcal{J}_z$ (which is closely related to q_z) is suggested. The distortion of the spectrum by the finite resolution of an electrostatic spectrometer is also given. The results are used in connection with a planned measurement of the proton recoil spectrum in neutron decay. Author

N69-36708*# California Univ., Berkeley. Space Sciences Lab.
DYNAMICAL THEORY ON LOW ENERGY ELECTRON DIFFRACTION Final Report
Harold P. Smith Jr. [1969] 19 p refs *Its* No. 10, Issue 30
(Grant NGR-05-003-275)
(NASA-CR-105758) Avail: CFSTI CSCL 20H

An extended version of the Bethe theory of low energy electron diffraction (LEED) is presented and successfully applied to a computation of diffracted beam intensity as a function of wavelength of the incident electron. The results show consistent behavior with respect to parameter variation and are in reasonable agreement with measured beam intensities. Author

N69-36718# Massachusetts Inst. of Tech., Cambridge.
THERMAL NEUTRON CAPTURE GAMMA-RAY SPECTRA OF THE ELEMENTS

Norman C. Rasmussen, Yoshiyuti Hukai, Tamon Inouye, and Victor J. Orphan Jan. 1969 144 p refs
(Contract AF 19(628)-5551)
(AD-688955; SR-2, MITNE-85; AFCRL-69-0071) Avail: CFSTI CSCL 20/6

A determination of the energy and intensity of the gamma rays resulting from thermal neutron capture in 74 natural elements is reported. The measurements include energies above 200 keV and were done with a Ge(Li) detector. Author (TAB)

N69-38753# United Kingdom Atomic Energy Authority Culham (England). Translations Office.
BORN APPROXIMATION EXCITATION CROSS SECTIONS FOR ATOMS BY ELECTRONS
L. A. Vainshtain et al May 1968 43 p refs Transl. into ENGLISH from Lebedev Report no. 6, (Moscow), Jun. 1967 p 1-32
(CLM-TRANS-13) Copyright. Avail: HMSO: 8s

Theoretical cross sections calculations were made using the simplest method, the Born approximation, in atomic collision theory. The integrated coefficient where averaging is carried out over a wide range of energies was studied. A review of expressions and parameter tables of electron transitions is given from which the effective excitation cross sections and coefficients in Born approximation can be obtained. J.A.M.

N69-38775# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Lab.
A HIGH RESOLUTION STUDY OF THE Pu 239 (d, pf) REACTION
H. J. Specht, J. S. Fraser, J. C. D. Milton, and W. G. Davies Jul. 1969 16 p refs Presented at the IAEA Symp. on the Phys. and Schem. of Fission, Vienna, 28 Jul.-1 Aug. 1969
(AECL-3376) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $0.50

The (d,pf)-reaction on ^{239}Pu was studied at a bombarding energy of 11.5 MeV. A Brown-Buechner magnetic spectrograph equipped with a 1 m long hyperbolically shaped wire spark chamber detected protons at an angle of 132.5° with respect to the incoming dueteron beam. The energy resolution of the system was ~18 keV FWHM. The angular distribution of fission fragments was measured on coincidence with protons. Particular attention was given to the excitation energy regio region from 4.3 MeV to 5.2 MeV in the residual nucleus. Preliminary analysis shows prominent structure in the fission probability consisting of at least seven lines in the peak. The weak plateau below the main peak also appears to contain several lines. The fission fragment angular distribution data are consistent with the interpretation that all lines in the region 4.69 to 5.16 MeV have the same angular distribution. The width of the lines in all cases is that of the experimental resolution and their spacing is consistent with present ideas of the level density in the second well. Author

N69-38833# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
PHOTOIONIZATATION WITH ATOMIC BEAMS. PART 1: ZINC ATOMS BETWEEN 247 AND 1242 ANGSTROMS; PART 2: CADMIUM ATOMS BETWEEN 8.99 AND 83 eV AND ZINC ATOMS BETWEEN 27.36 AND 65 eV
Halstead Harrison, Richard I. Schoen, Keith E. Schubert, and R. B. Cairns Dec. 1968 75 p refs Submitted for publication
(DI-82-0779) Avail: CFSTI

The wavelength dependences of the photoionization cross sections of zinc atoms were measured with a modulated atomic beam and pulsed, dispersed vacuum-ultraviolet radiation. The photoions were mass analyzed, counted, and digitally demodulated. Apparatus and technique are described, and results are presented for singly charged ions at wavelengths between 247 and 1243 Å. Author

N69-38901*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MULTIGROUP CALCULATIONS OF RESONANCE NEUTRON CAPTURE IN A THICK SLAB OF DEPLETED URANIUM
Gerald P. Lahti Washington Sep. 1969 16 p refs
(NASA-TM-X-1878) Avail: CFSTI CSCL 20H

Capture rates were calculated, using various widely used group cross section generating techniques, for the case of 3 to 11 eV neutrons in a 3.14-cm thick slab of depeleted uranium sandwiched between polyethylene slabs. An experimentally verified fine group cross section generating procedure, GAROL, and multigroup neutron transport calculations for the 3- to 11-eV region provided the standard spatial capture distribution for comparison. The one group cross section calculated by GAROL preserves the total neutron capture rate. Other one group formulations such as obtained with GAM-2 are inappropriate for use in a transport calculation in a resonance absorber and can result in a factor of 2 underestimate in neutron capture rate. Author

N69-38908 Texas Christian Univ., Fort Worth.
ELECTRONIC STRUCTURE OF THE R CENTER IN LiF
John Carroll Knowles, Jr. (Ph.D. Thesis) 1968 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-744

The electronic states associated with the R_1 and R_2 transitions of the R color center in LiF were studied. The R center was taken to be three F centers in an equilateral triangle configuration and the F center an electron trapped at a fluorine vacancy. The ions surrounding the vacancy are taken to be point charges and a pseudo-potential is introduced to account for the structure of nearest neighbor ions. The F electron is described by a 2s Slater type orbital, and the ground state energy is calculated and found to be -5.66 ev which is in good agreement with previous work. Group theory is used to approximately solve the secular problem. The energies of the trial states are calculated and the states are then assigned to the transitions of interest. The ground state and the R_1 and R_2 excited states are of symmetry type E. The R_1 and R_2 transition energies are found to be 3.62 ev and 2.88 ev. These values are within 10% of the observed values. Dissert. Abstr.

N69-38908 Rensselaer Polytechnic Inst., Troy, N.Y.
ELECTROMIGRATION AND THERMOMIGRATION IN GAMMA-URANIUM
John Francis D'Amico (Ph.D. Thesis) 1968 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-2456

Atom transport in gamma-uranium due to the influence of large direct currents (electromigration) and thermal gradients (thermomigration) was measured by observation of local dimensional changes in high-purity uranium rods which were resistively heated with d.c. or a.c. in high vacuum. A travelling microscope of resolution to one micron was used to measure both radial and longitudinal changes in dimension, the latter by observation of displacements of surface markers. Atom fluxes determined from the observed dilatations combined with measurements of temperature and current density, were used to evaluate DZ^*/I and DQ^*/I over

the entire temperature range of the gamma phase. The effective charge number and the heat of transport were obtained using values of D obtained from tracer diffusion experiments. Here f is the correlation factor. In the electromigration experiments, mass transport was observed toward the anode, with Z^*/f equal to -1.6 ± 0.1. In the thermomigration experiments, mass transport was observed toward the cooler regions, with Q^*/f equal to +4.7 ± 0.7 kcal/mole. Applying the simple kinetic model, and assuming a vacancy mechanism, this value of Q^*/f gives vacancy migration and formation enthalpies of approximately 15.8 and 10.9 kcal/mole, respectively. No changes in diffusion rate were observed during course of the experiments, indicating that the defects responsible for the diffusion are quite stable and cannot be annealed out.
Dissert. Abstr.

N69-36913 Fordham Univ., New York.
A NUCLEAR MAGNETIC RESONANCE STUDY OF ORDER-DISORDER IN FERROMAGNETIC ALLOYS
Thaddeus Joseph Burch (Ph.D. Thesis) 1968 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-2577

Ferromagnetic alloys, which also exhibit crystallographic order at specific compositions, were studied, by spin-echo nuclear magnetic resonance. The hyperfine fields at both Fe and Si nuclei in Fe_xSi_{1-x} for compositions between 18.4 and 26.5 at% Si at 1.4°K. At Al spectra in FeAl alloys show very broad distributions with maxima at about 52 KOe in disordered alloys and in annealed alloys from 14 to 21 at% Al. In the Ni_3Fe ordered alloys, Ni lines were detected at about 39.7, 53.6, 63.5, and 70.9 MHz and are identified as coming from Ni sites with 1, 3, 4, and 5 Fe nn. The Fe resonance, known to occur at about 40 MHz, is weak and mixed with the Ni resonance. The integrated intensities and fields of the Ni lines are consistent with a model of an imperfectly ordered stoichiometric alloy. In Ni_3Mn the Ni spectrum of the long-range ordered alloy has lines at 38.5, 63.0, and 78.0 MHz and is similar to the spectrum of the short-range ordered alloy. However, the Mn resonance at about 345 MHz in the long-range ordered alloy falls at about 285 MHz in the short-range ordered alloy. The spectra of Ni and Co in both disordered and annealed Ni75 Co25 alloys are very similar and confirm the absence of long-range order in this system. In the Ni3Fe, Ni3Mn, and NiCo alloys the Ni field shift per 1st nn is linear and about 5 MHz per μB of the neighbor.
Dissert. Abstr.

N69-36914 California Inst. of Tech., Pasadena.
A MULTIPLE SCATTERING PROBLEM
Athanassios Dimitrios Varvatsis (Ph. D. Thesis) 1968 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-539

The problem of the interaction of the electromagnetic radiation with a statistical distribution of nonmagnetic dielectric particles immersed in an infinite homogeneous isotropic, nonmagnetic medium is analyzed. The wavelength of the incident radiation can be less, equal or greater than the linear dimension of a particle. The distance between any two particles is several wavelengths. The total scattering field is obtained as a series the several terms of which represent the corresponding multiple scattering orders. The second and third order intensity terms are explicity computed. The method used suggests a general approach for computing any order. The first order polarization of the scattered wave is determined. The ensemble average of the Stokes parameters of the scattered wave is explicitly computed for the second order. A similar method can be applied for any order. If the medium is lossy the general approach employed for the lossless case is still valid. Only the algebra increases in complexity.
Dissert. Abstr.

N69-36924*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MOLECULAR VIBRATION SPECTRA FROM FIELD EMISSION ENERGY DISTRIBUTIONS
Dennis J. Flood Washington Sep. 1969 23 p refs
(NASA-TN-D-5423) Avail: CFSTI CSCL 20H

A calculation is presented which predicts a change in the energy distribution of field emitted electrons due to electron–molecule interactions at the metal–vacuum interface. The derivative of the energy distribution of electrons which undergo such an interaction should yield information on the infrared absorption spectra of the absorbed molecules.
Author

N69-36929*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVALUATION OF A TECHNIQUE FOR MEASURING ION ENERGY LOSS IN VAPOR-DEPOSITED MATERIALS
Joseph S. Heyman Washington Sep. 1969 18 p refs
(NASA-TN-D-5430) Avail: CFSTI CSCL 20H

A technique for measuring ion energy loss values for vapor-deposited materials has been investigated. The technique employed vapor-depositing the desired thickness of material on a floated gold substrate target. The target was then placed in a proton beam while silicon semiconductor detectors monitored simultaneously the initial and exit beam energy. The investigation covered a wide range of target thicknesses (2 to 26 μm) and energies (0.5 to 3.4 MeV). A computer program was developed to reduce the data and correct for the gold substrate and the finite sample thickness. A comparison of these data with values reported in the literature indicates agreement to within ±1.6 percent over the tested ranges. Although the technique has been evaluated for protons in aluminum it is expected to yield accurate results for other ions and/or materials.
Author

N69-36931*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS OF THE GAMMA-RAY-BACKSCATTER TECHNIQUE FOR DIRECT MEASUREMENT OF THE DENSITY OF THE MARTIAN ATMOSPHERE
Peter J. Le Bel Washington Sep. 1969 28 p refs
(NASA-TN-D-5431) Avail: CFSTI CSCL 20H

Studies have been conducted of a technique that uses the backscattering of gamma radiation emitted by a radioisotope source to measure the ambient density of the Martian atmosphere during entry of a spacecraft into the atmosphere. The results show the feasibility of the measurement up to an altitude of about 100,000 feet (30.5 km) in the least dense of the Voyager-Mars model atmospheres. No probes or special windows through the spacecraft skin or heat shield are required because of the penetrating ability of the radiation. A source strength at Mars of 20 curies (1 curie = 3.7×10^{10} disintegrations per second) of gamma radiation is required. The measurement is essentially unaffected by the composition of the atmosphere by the shock layer, and by motions of the vehicle. An engineering-model density sensor, which has been fabricated and tested, has a mass of 5 pounds a volume of 90 $inches^3$ and required 5 watts of power for operation. Further miniaturization of the device appears practical. Sterilization of the sensor is not expected to present major problems.
Author

N69-36950 Princeton Univ., N.J.
A STUDY OF ELECTRON BOMBARDMENT INDUCED CONDUCTIVITY IN THERMALLY GROWN SILICON DIOXIDE
George Alfred Wardley (Ph.D. Thesis) 1968 275 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.55 Order No. 69-2569

An electron beam was used to produce an injecting contact at one side of a 1 to 3 micron layer of SiO_2, thermally grown on Si, by bombarding through a thin grounded aluminum gate electrode. The sample currents resulting from this bombardment, (both steady state and transient), were studied as a function of bias applied to the silicon. The steady state current voltage characteristic has three distinct regimes, and these currents are associated with a space charge, whose build up can be detected by transient measurements. At room temperature this space charge is stable for periods of the order of 10^6 to 10^7 seconds as long as the bombarding beam is turned off, indicating that there is very slow thermal release charge from traps. Photon excitation processes related to the bombarding beam are much larger than thermal processes, so most of the change in stored charge occurs during bombardment. These beam related excitation processes result in a linear dependance of sample current on beam current. The quadratic regime was interpreted as a shallow trap controlled electron space charge limited current; the linear regime as a photoconduction current dominated by hole flow; and the quartic regime as a space charge controlled field emission of electrons from the silicon. Dissert. Abstr.

N69-36980# Oak Ridge National Lab., Tenn.
IODINE-132: REVIEW OF PROPERTIES, USES, AND METHODS OF PREPARATION
Martha Gerrard, John J. Pinajian, and P. S. Baker Jan. 1969 27 p refs
(Contract W-7450-eng-26)
(ORNL-IIC-4) Avail: CFSTI

Literature on the properties, uses, and methods of preparing ^{132}I (~125 references) is reviewed. Author

N69-37007# Air Force Cambridge Research Labs., Bedford, Mass.
BACKDIRECTED ELECTRON YIELDS FROM METALS BOMBARDED BY 0.4-MeV TO 1.4 MeV ELECTRONS
A. Robb Frederickson Apr. 1969 26 p refs Sponsored in part by DASA *Its* Phys. Sci. Res. Papers No. 373
(AD-688809; AFCRL-69-0144) Avail: CFSTI CSCL 20/8

The total backdirected electron yield due to 0.4- to 1.4-MeV electrons incident normally on aluminum, copper, and lead has been measured. Retarding-potential measurements were taken to investigate the low-energy component of the backdirected flux. Careful checks were made to ensure that no error was introduced from bremsstrahlung or other external sources of electron emission. The results show that the low-energy emission is much less than previously reported and that the total emission lies between the results of Dressel (1966) and those of Wright and Trump (1962). Improvements in the design of the apparatus are described and the effects of the improvements are demonstrated. Author (TAB)

N69-37068# Sheffield Univ. (England).
THE CONTRIBUTIONS OF NEUTRON AND X-RAY DIFFRACTION TECHNIQUES
G. E. Bacon *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 57–75 refs (See N69-37063 21-06)
Avail: SOD $4.00

Applications of neutrons and X-rays in studying molecular dynamics and the structure of solids are examined. Author

N69-37068# London Univ. (England). Kings Coll.
INFRARED AND RAMAN STUDIES ON MOLECULAR STRUCTURE AND MOTION IN CONDENSED PHASES
G. R. Wilkinson *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 77–133 refs (See N69-37063 21-06)
Avail: SOD $4.00

Principles of infrared and Raman spectroscopy are summarized and results are cited for investigations of specific systems such as: elemental covalent crystals, ionic crystals, molecular crystals, polymers, liquids, hydrogen bonding, and classifying crystalline solids. E.C.

N69-37067# United Kingdom Atomic Energy Authority, Harwell (England).
NEUTRON INELASTIC SCATTERING STUDIES OF MOLECULAR SOLIDS AND LIQUIDS
P. A. Egelstaff *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 135–156 refs (See N69-37063 21-06)
Avail: SOD $4.00

Radiation scattering techniques are reviewed, several neutron spectrometers are described, and neutron scattering theory is outlined. Also discussed are examples of neutron inelastic scattering by molecular systems, including coherent scattering by molecular crystals, in coherent scattering by hydrogenous systems, and molecular rotation. Neutron scattering applications in isotopic substitution, molecular series, and motion of guest molecules are also mentioned. E.C.

N69-37068# Oxford Univ. (England). Physical Chemistry Lab.
THE PRINCIPLES INVOLVED IN THE STUDY OF MOLECULAR MOTION IN SOLIDS BY NUCLEAR MAGNETIC RESONANCE
R. E. Richards *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 157–174 refs (See N69-37063 21-06)
Avail: SOD $4.00

The mechanisms of the various interactions which may cause line broadening in n.m.r. spectra are outlined and the conditions for line narrowing by molecular motion considered. The magnetic dipole-dipole and electric quadrupole interactions provide the most important process by which Zeeman energy can be transferred among the nuclei themselves, by so-called spin-spin relaxation, and by which energy may be exchanged between the nuclear spin system and the thermal motion of the molecules in the lattice, by spin lattice relaxation. These two processes are usually characterized by the spin-spin relaxation time, relaxation time, T_2, and the spin lattice relaxation time, T_1. By studying the variation of T_1 and T_2 with temperature, the frequency of the molecular motion and its temperature dependence can be found. The principles of these studies, and some of the complications which can occur, are discussed. Author

N69-37072# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
THE DETECTION OF ATOM TUNNELING IN SOLIDS
I. Pelah and Y. Imry *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 223–226 refs (See N69-37063 21-06)
Avail: SOD $4.00

Direct measurements of tunneling employing the interaction of the tunneling atom with external radiation are discussed. This includes experiments like IR absorption, neutron scattering, and Mossbauer effect. Ways in which effects peculiar of tunneling are directly detectable are described. Existing IR and neutron studies of KDP are reviewed and some new experiments suggested.

The behavior of radiation emitted, absorbed or scattered by two distinct sources is well known. A basic problem is that of one source tunneling between two positions. Interesting interference effects can be obtained. A mathematically simple two minimum model is discussed which illustrates the above points and is, in fact, a good approximation for the protons in KDP. Author

N69-37107# Toronto Univ. (Ontario). Dept. of Physics.
MOLECULAR ROTATION IN CONDENSED PHASES OF SIMPLE MOLECULES
M. Blumenfeld *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 441–447 refs (See N69-37063 21-06)
Avail: SOD $4.00

The molecular rotation in condensed phases is studied by spectrum analysis in terms of the moments of intensity distribution in the Raman spectra. The spectral band moment analysis for liquid oxygen and methane, and solid methane are tabulated. The correlation function analysis of these simple molecules is discussed, and it is concluded that the rotational motion of these molecules is not free. F.O.S.

N69-37108# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.
CORRELATION OF INFRARED AND INELASTIC NEUTRON SCATTERING SPECTRA OF SOLID METHANE
Ashok K. Agrawal and Sidney Yip *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 449–452 refs (See N69-37063 21-06)
(Contract DAHC4-67-C-0011)

The spectra of infrared absorption, Raman scattering and inelastic neutron scattering are studied to provide information about rotational motions in molecular systems. In this paper correlations of infrared and neutron spectra of solid methane near its λ-point are considered. An effective frequency spectrum which can be used in cross-section calculations and which is in qualitative agreement with that inferred from the neutron data is obtained. An approximate thermodynamic frequency distribution function which leads to a reasonable estimate of the heat capacity is deduced. Author

N69-37112# Oxford Univ. (England). Physical Chemistry Lab.
SPECTRAL ASSIGNMENT IN INELASTIC NEUTRON SCATTERING SPECTROSCOPY BY ATOMIC SUBSTITUTION TECHNIQUES
J. W. White *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids p 463–468 refs (See N69-37063 21-06)
Avail: SOD $4.00

Two advantages of the neutron scattering method are identified: (1) Transitions between molecular and crystal states that cannot be seen by optical spectroscopy, because they are forbidden by optical selection rules are observable by neutron scattering. (2) The intensities of scattering in largely incoherent systems, such as those containing hydrogen, can be directly related through their angular dependence to the amplitudes of motion associated with particular vibrational frequencies. It is therefore possible by means of isotopic or atomic substitution to assign different parts of the inelastic scattering spectrum from hydrogenous systems to the motion of different parts of the molecules concerned. This appears to be true both for simple molecular systems, such as liquids and solids, and also for polymers containing simple units. A.C.R.

N69-37117# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.
EPITHERMAL NEUTRON INELASTIC SCATTERING BY POLYETHYLENE
W. E. Moore, G. J. Korousc, L. J. Esch, and K. W. Seemann *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 547–551 refs Prepared in Cooperation with Rensselaer Polytech. Inst. (See N69-37063 21-06)
(Contracts W-31-109-eng-52; AT(30-3)-328)
Avail: SOD $4.00

A neutron scattering measurement system is described which utilizes an electron linear accelerator and phased chopper to produce short neutron bursts of a desired energy. Scattered neutron energies are measured by time-of-flight. Incident energies can be chosen over a range of 0.1 to 1 eV, enabling the study of high energy-transfer modes of molecular systems. Double-differential cross sections were measured for polyethylene using five incident energies and five scattering angles. The experimental system is treated, and examples of data obtained are shown. A.C.R.

N69-37140# Gulf General Atomic, San Diego, Calif.
MEASUREMENT OF GAMMA-RAY PRODUCTION CROSS SECTIONS FOR NITROGEN AND OXYGEN Final Report
V. J. Ophan and C. G. Hoot Jan. 1969 98 p refs
(Contract DASA01-68-C-0016)
(AD-689388; GA-8006; DASA-2267) Avail: CFSTI CSCL 20/8

A gamma-ray production cross section measurement facility is described in this report. This facility uses a LINAC as a neutron source and a Ge(Li) as the gamma detector. The facility was used to measure the gamma-ray production cross sections of nitrogen and oxygen for incident neutron energies of up to 18 MeV. The results are tabulated, graphed, and compared with other measurements. Author (TAB)

N69-37177# Stanford Univ., Calif.
A SUPERCONDUCTING LINEAR ACCELERATOR AND THE USE OF SUPERCONDUCTIVITY IN SOME FUNDAMENTAL EXPERIMENTS IN PHYSICS
William M. Fairbank *In* Va. Univ. Phys. of Superconducting Devices 1967 20 p refs (See N69-37176 21-09)
Avail: CFSTI

Because of the low temperature problem involved in linear accelerator construction, new methods were investigated to eliminate some of the problems of the accelerator. An attempt is made to apply nonzero resistance of superconductors and superfluid properties of liquid helium to improve the construction and performance of the accelerator. Results indicate superconductivity coupled with low temperature environment shows possible improvements can be made. E.H.W.

N69-37186# Bell Telephone Labs., Inc., Murray Hill, N.J.
QUANTUM GENERATION AND DETECTION OF PHONONS IN SUPERCONDUCTORS
A. H. Dayem *In* Va. Univ. Phys. of Superconducting Devices 1967 1 p Submitted for publication (See N69-37176 21-09)
Avail: CFSTI

In a superconductor an excited quasi-particle of energy E (measured from the Fermi level) relaxes first to the top of the energy gap (of width 2Δ) emitting a phonon of energy $(E-\Delta)$ and then recombines with a mate to form a Cooper pair with the

emission of a phonon of energy 2Δ. In the experiment we use two identical Sn-SnO_2-Sn tunnel diodes evaporated on opposite ends of a sapphire single crystal. In the first diode, the generator, quasi-particles are excited by tunneling; they then relax, recombine and generate phonons, which are detected by the second diode, the receiver. Using pulse techniques it is established that the received signal is produced by phonons propagating in the sapphire crystal from the generator to the receiver. The dependence of the received signal on the frequency of the generated phonons shows that the receiver responds only to phonons of energy $\geq 2\Delta$. Thus a tunnel diode can be used as a quantum counter. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N69-38023 Rensselaer Polytechnic Inst., Troy, N.Y.
THE HELICAL INSTABILITY OF THE POSITIVE COLUMN MAGNETOPLASMA
Robert Michael Quinn (Ph.D. Thesis) 1968 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-2476

An improved understanding of the nature of the helical instability of the positive column was obtained by the application of theoretical and experimental techniques which are new to this field. The techniques of the theory of complex functions were applied to the examination of the properties of the dispersion relation of this system. An investigation of the loci of the poles of the response function in the complex wave-number plane as a function of complex frequency established the convective nature of this instability. A mapping technique was utilized to predict the critical values of the system parameters. Close agreement between theory and experiment is found utilizing both experimental results previously available and new experimental results obtained for a different range of the experimental parameters. The mapping technique also shows that the method used previously to obtain predictions of the onset conditions for instability contains a mathematical inconsistency. This is shown to lead to significant error in the predicted values of the critical parameters under certain experimental conditions. The subthreshold excitation technique was used to measure the real and imaginary parts of the wavenumber of the helical perturbations. The general features of the behavior of these parameters predicted by the mapping technique are confirmed by the experiment. Dissert. Abstr.

N69-38201 Virginia Polytechnic Inst., Blacksburg.
ELECTROSTATIC OSCILLATIONS IN INHOMOGENEOUS PLASMAS
Lee Douglas Staton (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-3038

The problem of longitudinal electrostatic oscillations in inhomogeneous, one-dimensional plasmas is examined in several areas. The question is considered whether or not the Vlasov - Maxwell equations will allow a plasma system to evolve naturally toward a preassigned stationary, inhomogeneous state. For the case where the stationary state is characterized by an energy distribution function, which is a constant for all energies up to a given maximum and zero for energies beyond, an extremization principle is developed indicating that the total system energy is a minimum for the plasma. This stationary state then is inaccessible in general for a plasma prepared initially in a less restrictive manner. Further, such an inhomogeneous, stationary state is necessarily stable, a fact which is demonstrated directly by treating this case through an integral equation method. Electrostatic oscillations in more general cases are treated through the Fourier–Hermite transformation of the coordinate and velocity variables. Dissert. Abstr.

N69-36214*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
ON THE INFLUENCE OF AN ELECTROMAGNETIC FIELD CREATED BY EXTERNAL CURRENT ON THE DISTRIBUTION OF PLASMA DENSITY [O VLIYANII ELEKTROMAGNITNOGO POLYA, SOZDAVAYEMOGO VNESHNIMI TAKAMI, NA RASPREDELENIYE PLOTNOSTI PLAZMY]
V.V. Demchenko et al Washington NASA Aug. 1969 6 p ref Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 14, no. 2, 1969 p 209–212
(Contract NASw-1692)
(NASA-TT-F-12395) Avail: CFSTI CSCL 20I

The density distribution of a confined plasma due to an electromagnetic field produced by external modulated currents is investigated. Formulas are obtained for fields and plasma densities in the case of a plane-parallel layer of plasma and in the case when a cylindrically symmetrical plasma is confined by an electromagnetic field produced by an external azimuthal current flowing through the surface of the cylinder. Author

N69-36391# Institut Franco-Allemand de Recherches, St. Louis (France).
DIAGNOSIS OF WEAKLY IONIZED PLASMAS USING A FABRY-PEROT MICROWAVE RESONATOR. PART 1: THEORETICAL STUDY [DIAGNOSTIC DE PLASMAS FAIBLEMENT IONISES A L'AIDE D'UN RESONATEUR HYPERFREQUENCE FABRY-PEROT. 1: ETUDE THEORIQUE
G. Stern 14 Jan. 1969 43 p refs In FRENCH; GERMAN summary
(ISL-T-1/69) Avail: CFSTI

Huygen's refraction principle is used to determine the structure of oscillating modes in a Fabry–Perot microwave resonator with spherical mirrors. The concept of resonance magnification is described in relation to the resonator parameters. Investigation of disturbances in the interior of the resonator, caused by the development of a plasma layer, point out the importance of the Fabry–Perot resonator for diagnoses on weakly ionized plasmas. This kind of diagnosis will be applied in relaxation measurements on electron density behind shock waves in air. Transl. by G.G.

N69-36398# Institut Franco-Allemand de Recherches, St. Louis (France).
TRANSMISSION AND REFLECTION MEASUREMENTS WITH MILLIMETER WAVES ON DETONATION PLASMAS OF SOLID EXPLOSIVES [TRANSMISSIONS- UND REFLEXIONSMESSUNGEN MIT HILFE VON MILLIMETERWELLEN AN DETONATIONS- PLASMEN FESTER SPRENGSTOFFE]
H.-D. vom Stein and B. Koch 7 Feb. 1968 21 p refs In GERMAN; FRENCH summary
(ISL-T-3/68) Avail: CFSTI

An experimental arrangement is described which in principle measures the transmission and reflection coefficients of a plasma in a hollow waveguide that was produced by the detonation of

solid explosives. From the measurements, the conductivity and the relative dielectric constant are calculated. Because the wave length of 8.6 mm that was used represents only limited spatial resolution, no quantitative data were obtained for the conductivity profile of the detonation front. The results therefore constitute mean values over distances of a few millimeters within the gas following the detonation front. Transl. by K.W.

N69-36400# Institut Franco-Allemand de Recherches, St. Louis (France).
METHODS FOR INVESTIGATING IONIZED WAKES IN FREE-FLIGHT TUNNEL [LES METHODES D'ETUDE AU TUNNEL DE TIR DE L'IONISATION DANS LES SILLAGES]
M. Laug, M. J. Pierson, and G. Stern 3 Nov. 1967 100 p refs In FRENCH; GERMAN summary
(ISL-9/67) Avail: CFSTI

The ionization of wakes behind hypervelocity projectiles is examined as encountered in free-flight tunnels in which high altitudes can be simulated by pressure reduction. Methods of plasma diagnostics for analyzing the ionization processes are discussed, including resonant cavities, hyperfrequency interferometry with beam focusing, high-frequency Fabry-Perot resonators, radar probes, magnetic probes, and electron beams. Some measured results are presented of ionization kinetics in air, electron collision frequencies, ablation effects, and effects of impurities and contaminants. Transl. by K.W.

N69-36851# Tokyo Univ. (Japan).
INST. OF SPACE AND AERONAUTICAL SCIENCE. LONGITUDINAL DIELECTRIC FUNCTION FOR A MAGNETOPLASMA
Yukikazu Itikawa and Tadatsugu Hatori Jul. 1969 15 p refs
(ISAS-441-Vol-34-No-8) Avail: CFSTI

Longitudinal dielectric function, $K(k, \omega) = k \cdot \epsilon(k, \omega) \cdot k/k^2$ is investigated quantitatively for a magnetoplasma with a Maxwellian velocity distribution. Here ϵ is the dielectric permeability tensor defined as a function of wave vector k and frequency ω. Some characteristic features of K are shown and asymptotic forms are given for several limiting cases. Author

N69-36758*# National Aeronautics and Space Administration. Electronic Research Center, Cambridge, Mass.
SPECTROSCOPIC STUDY OF A HELIUM ARC
Victor E. Scherrer Washington Sep. 1969 13 p refs
(NASA-TN-D-5396) Avail: CFSTI CSCL 20I

A plasma source which has the characteristics desired for astrophysical spectral measurements is described. A high frequency (1 MHz) capacitor discharge through an arc tube containing needle electrodes heated helium to kinetic electron temperatures varying from 10 eV to over 100 eV. Diagnostic measurements included time resolved spectroscopy and high speed photography. Author

N69-36921# Oxford Univ. (England). Dept. of Engineering Science.
THE THEORY OF FREE-CONVECTION ARC COLUMNS
Richard Rowe 1968 62 p refs
(OXU-1-045-68) Avail: CFSTI

The heat transfer from a nitrogen free-convection electric arc column is investigated using the channel model and the electrode distance as the characteristic length, assuming axisymmetric, steady and laminar flow, local thermodynamic and chemical equilibrium, and some limiting conditions on radical velocity, voltage, axial temperature and velocity gradients. ESRO

N69-36939*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
FEASIBILITY OF DETECTING RADIATION SCATTERED FROM A PLASMA
Melville Clark, Jr. Washington Sep. 1969 56 p refs
(NASA-TN-D-5311) Avail: CFSTI CSCL 20I

It is shown that it is possible to detect radiation scattered from a plasma in doppler-shifted lines. The method provides a way of measuring the fluctuation in plasma charge density. Author

N69-37005# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE ENERGY BALANCE OF THE DISCHARGE INTERVAL DURING THE GENERATION OF JETS BY THE EROSION OF ELECTRODES
A. V. Nikolaev, et al 13 Mar. 1969 14 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Tekhn. Nauk (Novosibirsk), no. 1, 1967 p 120–125
(AD-688146; FTD-MT-24-514-68) Avail: CFSTI CSCL 20/9

Energy conditions were investigated which determined the generation of plasma on account of graphite anode erosion in an Ar atm. Arc current was 500-540 amp. Integral radiation of individual discharge paths and arc and anode column temps. were measured. The efficiency was 2.7-3 percent. Author (TAB)

N69-37041# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
LINEARIZED MAGNETOGASDYNAMIC CHANNEL AND JET FLOW
F. Edward Ehlers May 1969 22 p refs Presented at the CNRS Intern. Colloq. on Classical and Relativistic Magnetohydrodyn., Lille, 16–20 Jun. 1969 *Its* Mathematical Note 603
(AD-688110; D1-82-0846) Avail: CFSTI CSCL 20/9

The equations of motion for a conducting gas in the presence of a magnetic and an electric field are linearized under the assumption of small magnetic Reynolds number and nearly parallel flow by expanding the perturbation flow quantities in powers of the magnetic interection parameter. In the first approximation the magnetic and electric fields act as body forces on the gas. The solution is obtained for the subsonic flow in a coaxial channel. A swirl type flow results if an electric potential is established between the two cylinders. By reducing the electric field and inner radius to zero, the solution for the subsonic flow in a tube is found. Graphs are presented for the perturbation velocity components and pressure in the tube induced by the magnetic field from a single current loop or a toroidal coil. The general solutions are given for the subsonic axially symmetric free jet and for both the subsonic and supersonic two dimensional free jet. The perturbation velocity components and jet shape are described for the magnetic field of a single current bearing wire. Author (TAB)

N69-37058# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A DESCRIPTION OF LASER-PRODUCED PLASMAS. PART 2: MICROSCOPIC PROCESSES
Frank J. Allen Apr. 1969 32 p refs
(AD-689439; BRL-MR-1975) Avail: CFSTI CSCL 20/9

Several experiments are described which, taken together, show that processes other than acceleration in transient electric

fields are of considerable importance in the production of the energetic ions observed in laser-produced plasmas. Alternative mechanisms are proposed and analyzed and some of the microscopic processes which take place in the plasma are discussed. A consistent explanation of the experimental results, some of which are quite fragmentary, is provided. The need is pointed out for good time- and space-resolved experiments in order to gain a more detailed understanding of the processes which take place in laser-produced plasmas. Author (TAB)

N69-37160# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRUCTURE OF NONCOLLIDING SHOCK WAVES AND DISSIPATION OF STRONG VARIABLES OF MAGNETIC FIELDS IN PLASMA

M. V. Babykin et al 6 Mar. 1969 26 p refs Transl. into ENGLISH from Russian Conf.

(AD-688090; FTD-MT-24-448-68) Avail: CFSTI CSCL 20/9

Different mechanisms of noncolliding heating of plasma were investigated by means of studying the structure of the front of direct shock waves depending on the initial magnetic field, and also by means of studying turbulent conditions of the current layer in an experiment of the theta-pinch type. Author (TAB)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N69-36007# Reactor Centrum Nederland, Petten.

AN LGOL PROGRAM FOR THE REFINEMENT OF NUCLEAR AND MAGNETIC STRUCTURES BY THE PROFILE METHOD

H. M. Rietveld Feb. 1969 87 p refs

(RCN-104)

A structure refinement method is described which does not use integrated neutron powder intensities, single or overlapping, but employs directly the profile intensities obtained from stepscanning measurements of the powder diagram. Nuclear as well as magnetic structures can be refined, the latter only when their magnetic unit cell is equal to or a multiple of the nuclear cell. The least squares refinement procedure allows, with a simple code, the introduction of linear or quadratic constraints between the parameters. The complete text of the Algol 60 program is given with a description of the format of the input tape. A test sample is included at the end of the report. Author (ESRO)

N69-36031# Johns Hopkins Univ., Baltimore, Md. Mechanics Dept.

DYNAMIC STUDY OF PLASTIC DEFORMATION USING NEW ULTRASONIC AND X-RAY TECHNIQUES

Robert E. Greene, Jr. *In* AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 51–65 refs Sponsored jointly by the Army and NSF (See N69-36026 21-32)

Avail: CFSTI

Three different techniques are demonstrated for studying the internal mechanisms associated with the plastic deformation of solids. All three techniques involve the interaction between low amplitude waves (elastic, visible light, X-ray) propagating through the solid and the internal strain field set up in the solid as a consequence of plastic deformation. The three techniques are dynamic in the sense that the various physical phenomena observed are recorded with motion picture cameras. The superior sensitivity of these techniques over conventional stress–strain curves is demonstrated. Author

N69-36032# Ballistic Research Labs., Aberdeen Proving Ground, Md.

THE MEASUREMENT OF TRANSIENT DISPLACEMENTS ALONG THE SIDE OF A METALLIC CYLINDRICAL ROD DURING THE PASSAGE OF A PLASTIC WAVE

J. H. Suckling and J. T. Frasier *In* AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 67–77 refs (See N69-36026 21-32)

Avail: CFSTI

The radial displacement provided by a constant velocity impact applied to one end of a cylindrical rod is studied by means of a streak interferometric technique. The resulting continuous spatial and temporal display of data has distinct advantages over that of other transducers which give their output parameters as a function of time at discrete points on the specimen. The sensitivity and detail of data collected with this technique over an extended portion of the specimen are considered necessary for the study of the constitutive relationships of solids at or near their yield point. Representative interferograms are shown and displacement data are reduced from them for direct comparison with predictions based on static stress-strain curves. A method is outlined which shows how the interferometric results might be used to establish the constitutive relationship of the material with minimal initial assumptions. Author

N69-36036# Manchester Univ. (England). Inst. of Science and Technology.

SHOCK WAVES AND THE KINETICS OF SOLID-SOLID TRANSITIONS

Y. Horie and G. E. Duvall (Washington State Univ.) *In* AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 127–141 refs (See N69-36026 21-32)

(Contract DA-04-200-AMC-1702(X); Grant AF AFOSR-1088-66)

Avail: CFSTI

Shock wave propagation is considered in solids which undergo phase changes wherein the transition rate depends upon deviations of the system from thermodynamic equilibrium. The simple relaxation relation, $d\alpha/dt = (\alpha(\text{equilibrium})-\alpha)/\tau$, where τ = relaxation time and α = mass fraction of the second phase, is assumed. A general constitutive relation for use with the flow equations is developed and applied with suitable approximations to the $\alpha \cdot \varepsilon$ transition in iron. The logic of direct numerical integration of the flow equations using this relation is displayed and the development of a shock wave in time is studied using an artificial viscosity. The transient solution is found to closely approach the permanent regime after about a dozen relaxation times. The difference between the first shock pressure and the static transition pressure decays approximately exponentially with a decay constant somewhat larger than the linear theoretical one. Some kinds of experiments required for study of the kinetics of transition are described. Author

N69-36049 Purdue Univ., Lafayette, Ind.

THERMAL CONDUCTIVITY OF n-TYPE GERMANIUM FROM 0.3 DEG K TO 4.2 DEG K

Bruce Leroy Bird (Ph.D. Thesis) 1968 69 p

Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-2889

The thermal conductivity of germanium doped with the Group V elements Sb, P, or As in the concentration range from

3×10^{14} to 3×10^{18} impurity atoms per cm^3 was measured in a recirculating He^3 cryostat capable of covering the temperature range from 0.3° to 4.2°K. Previous measurements of the thermal conductivity of n-type germanium in the liquid helium range (1.4° to 4.2°K) showed that shallow donors are very strong scatterers of phonons. The results of the present measurements were compared with calculated values for the thermal conductivity of n-type germanium. Inclusion of the effect of resonance fluorescence of phonons improves the agreement between theory and experiment for the thermal conductivity of Sb doped samples, if the effective radius of the ground state donor wave function is taken equal to that calculated assuming a simple hydrogenic model of the impurity. The presence of additional scattering at the lower temperatures for the Sb, P, and As doped samples may be evidence of an additional scattering mechanism, possibly that arising from the phonon-assisted hopping of the electron between donor atoms. Dissert. Abstr.

N69-36136 California Univ., Riverside.
MAGNETOCRYSTALLINE ANISOTROPY OF EUROPIUM SELENIDE
Ronald Franklin Brown (Ph.D. Thesis) 1968 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-2647

The first and second order magnetocrystalline anisotropy constants of EuSe were measured by a ferromagnetic resonance technique at microwave frequencies and 1.3°K on single-crystal spheres of about 100 microns in diameter. The angular dependence of the resonant field for rotation in a crystallographic plane yields both K_1/M and K_2/M. The ferromagnetic resonance linewidth was 60 oe. K_1/M, and K_2/M were measured to be -50 ± 6 oe and -83 ± 16 oe, respectively. The cubic crystal field splitting parameters b_4 and b_6 were determined to be 4.5×10^{-4} cm^{-1}/ion and -1.3×10^{-4} cm^{-1}/ion, respectively. The results are compared with those of EuO and EuS and with cubic host lattices that have been doped with Eu^{++} ions. Dissert. Abstr.

N69-36211 Georgetown Univ., Washington, D.C.
AN X-RAY DETERMINATION OF THE STRUCTURE OF THE 12-MOLYBDOCERATE(IV) ANION
David Dyer Dexter (Ph.D. Thesis) 1968 184 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-2702

The structure of the $[CeMo_{12}O_{42}]^{-8}$ anion was determined and refined by analysis of complete three-dimensional X-ray diffraction data. The 12-molybdocerate(IV) anion represents a new structural type of heteropoly anion which differs in two important respects from previously known heteropoly anions. The central atom (Ce) is an icosahedral 12-coordination with oxygen atoms with an average Ce-O distance of 2.51Å. Moreover, this is the first heteropoly anion in which MoO_6 octahedra have been found to share faces with one another. The 12-molybdocerate(IV) anion was studied in two crystalline forms. Although only the heavy atoms were found in the monoclinic modification, it appears that the anion has the same structure in both forms. The twelve molybdenum atoms are arranged at the corners of an icosahedron. As has been found in other heteropoly anions, the MoO_6 octahedra are not regular. The Mo atoms are displaced toward the outside of the anion. The possible utilization of this icosahedral structure by other central atoms is discussed. Dissert. Abstr.

N69-36260*# Techtran Corp., Glen Burnie, Md.
INJECTION AND MIGRATION OF CHARGES IN THE OXIDE OF A METAL-OXIDE-SEMICONDUCTOR STRUCTURE
K. Seminadsyar et al [1969] 16 p refs Transl. into ENGLISH from J. Phys. Chem. Solids (London), v. 29, no. 10, 1968 p 1709–1718 *Its* No. 26
(Contract NAS5-14826)
(NASA-CR-105629) Avail: CFSTI CSCL 20L

An $Al\text{-}SiO_2\text{-}Si$ sandwich is studied using both C(V) curves and direct measurement of the charge injected in the oxide. The abnormal drift observed can be explained by tunneling of charges from silicon into traps in the oxide, which may be associated with oxygen vacancies. U.V. radiation or annealing at 50°C induce a recovery of the drift either by neutralization of the injected charges or by charge redistribution in the oxide. Annealing at 180°C reduces the trap density near the silicon surface, and the abnormal drift thus disappears. Author

N69-36418# Pennsylvania State Univ., University Park. Materials Research Lab.
RELATION OF MECHANICAL PROPERTIES TO THE STRUCTURE OF IONIC SOLIDS Quarterly Report, 1 Jun.–31 Aug. 1968
K. Vedam and R. E. Newnham Watertown, Mass. Army Mater. and Mech. Res. Center 20 Sep. 1968 19 p refs
(Contract DA-19-0660-AMC-325(X))
(AD-688184; QR-9; AMMRC-CR-68-07/9) Avail: CFSTI CSCL 20/2

The need for employing the Langs x-ray topographic technique for delineating the dislocations which lie and operate in the basal plane of mica is emphasized. The application of this technique to a low-symmetry material like mica, needs special attention. The basic principles involved, the experimental details, as well as some preliminary results obtained with muscovite mica are presented. Author (TAB)

N69-36430# National Bureau of Standards, Washington, D.C.
STANDARD X-RAY DIFFRACTION POWDER PATTERNS
H. E. Swanson, H. F. McMurdie, M. C. Morris, and E. H. Evans Sep. 1969 192 p refs
(NBS-MONOGRAPH-25-Sect-7) Avail: SOD $1.50

Standard X-ray diffraction powder patterns are presented for 81 substances. Forty-five of these patterns represent experimental data and 36 are calculated. The experimental X-ray powder diffraction patterns were obtained with a Geiger or proportional counter X-ray diffractometer, using samples of high purity. All d-values were assigned Miller indices determined by comparison with computed interplanar spacings and from consideration of space group extinctions. The densities and lattice constants were calculated, and the refractive indices were measured whenever possible. The calculated X-ray powder diffraction patterns were computed from published crystal structure data. Both peak height and integrated intensities are reported for the calculated patterns. Author

N69-36494# Stanford Univ., Calif. Electronics Labs.
PROPERTIES OF GALLIUM PHOSPHIDE GREEN ELECTROLUMINESCENT DIODES
Eugene G. Dierschke Apr. 1969 93 p refs
(Contract DAHC04-69-C-0011)
(AD-688696; TR-5117-1; SU-SEL-69-021; AROD-2895-27-E) Avail: CFSTI CSCL 20/12

A study has been made of the electrical and optical properties of gallium Phosphide green electroluminescent diodes which were formed by zinc or beryllium diffusions into n-type sulfur-doped GaP grown by the vapor-phase epitaxial technique on GaAs substrates. The objective was to determine the dominant current transport mechanisms and the dominant radiative recombination processes and to study their dependences on the electron carrier concentration. Author (TAB)

N69-36528# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
CONTINUUM AND LATTICE THEORIES OF INFLUENCE OF ELECTRO-MECHANICAL COUPLING ON CAPACITANCE OF THIN DIELECTRIC FILMS
R. D. Mindlin Mar. 1969 31 p refs
(Contracts DA-28-043-AMC-01731(E); Nonr-4259(13))
(AD-688155; TR-13; ITR-4) Avail: CFSTI CSCL 20/12

It is suggested that an anomaly, observed by C.A. Mead in measurements of the capacitance of thin dielectric films, may be due to an electromechanical effect not accounted for in the classical, continuum theory of piezoelectricity. A solution of equations that include the additional effect is shown to be capable of accommodating the experimental data. It is demonstrated that the augmented equations, rather than the classical ones, are a continuum approximation to the equations of a lattice of shell-model atoms. Analogous equilibrium solutions of the lattice and continuum equations are almost identical. Author (TAB)

N69-36658*# Ohio State Univ., Columbus. ElectroScience Lab.
ELECTRON BEAM PUMPED LASER ACTION IN SELENIUM AND TELLURIUM WITH APPLICATIONS FOR TUNABLE BACKWARD PARAMETRIC OSCILLATIONS Final Summary Report
15 Jul. 1969 18 p refs
(Grant NGR-36-008-103)
(NASA-CR-105655; FR-2679-2) Avail: CFSTI CSCL 20B

The peculiar spiral chain structure of trigonal Te, Se, and HgS make these materials of special interest in the investigation of nonlinear optical phenomena. Since no known source (other than nature) produces cinnabar, attention was restricted to the elemental crystals. The pertinent optical properties of these materials are given. The large birefringence and nonlinear susceptibility suggest a variety of phase matched parametric interactions such as efficient second harmonic generation, up conversion, down conversion, and backward wave oscillation. The narrower transparency range of Te indicates that Se may be of more interest in certain applications requiring high intensity pumping such as can be obtained from ruby (0.694 m) or neodymium glass (1.06 m) laser. Either material could be pumped with the carbon dioxide (10.6 m) laser. Author

N69-36703# Army Electronics Command, Fort Monmouth, N.J. Electronic Components Lab.
MAGNETOELECTRIC EFFECTS IN SEMICONDUCTOR JUNCTIONS
W. J. Kitchen, Jr. Apr. 1969 28 p refs
(AD-688087; ECOM-3110) Avail: CFSTI CSCL 20/12

The effect of applying a transverse magnetic field on p-n junctions of Si and Ge has been investigated, and the results are presented. Included in this investigation are in-house fabricated devices as well as a variety of commercially available Si and Ge diodes. The effects observed were universally present in all junctions investigated and suggest, therefore, the possibility of using magnetic fields for evaluating the material parameters of processed semiconductor devices. Author (TAB)

N69-36718# Pennsylvania State Univ., University Park. Materials Research Lab.
INFRARED TRANSMITTING MATERIALS Final Report, 1 Jun. 1968–31 May 1969
William B. White Jun. 1969 86 p refs
(Contract N00014-67-A-0385)
(AD-688933) Avail: CFSTI CSCL 20/6

The report deals with the infrared transmitting properties of fluorite structure oxides and the heavy metal covalent oxides of bismuth and lead. Transmission data for single crystal ThO2 are given. IR data are presented for orthorhombic and tetragonal PbO, for SrPbO3 and Sr2PbO4, and for alpha-Bi2O3 and PbO.6Bi2O3. Near infrared spectra for the lead and bismuth oxide are also given. Author (TAB)

N69-36720# Princeton Univ., N.J. Dept. of Electrical Engineering.
THE INFLUENCE OF CHEMISORPTION ON THE ELECTRONIC PROPERTIES OF THIN SEMICONDUCTORS: OXYGEN CHEMISORPTION ON THE (11-20) SURFACE OF CdS
Thomas A. Goodwin (Ph.D. Thesis) and Peter Mark Jun. 1969 169 p refs
(Contract N00014-67-A-0150)
(AD-688945; TR-2) Avail: CFSTI CSCL 20/2

A theoretical investigation of the effects of chemisorption surface states on the equilibrium conductivity of thin, wide bandgap semiconductors is presented. Criteria are established for the detection and characterization of chemisorption by electrical measurements on the adsorbent. Measurements with oxygen (acceptor adsorbate) on CdS (n-type adsorbent) confirm the essentials of the theory: (1) There is little or no change in the adsorbent conductivity unless the (pressure dependent) adsorbate surface state concentration exceeds the adsorbent bulk electron density per unit surface area, and the depth of the surface state below the conduction band exceeds the surface potential necessary to completely deplete the adsorbent bulk. (2) Satisfaction of these conditions produce large changes in the electrical properties of the adsorbent on chemisorption, in both the magnitude of the equilibrium conductivity and in its activation energy. A quantitative study of these effects yields the energy level of the adsorbate and the pressure dependent surface state concentration. Author (TAB)

N69-36736# General Electric Co., Syracuse, N.Y. Semiconductor Products Dept.
ECONOMICAL RELIABILITY PROGRAM DESIGN
B. L. Bair and A. Fox *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 111–126 refs Presented at Ann. Symp., Chicago, 1969 (See N69-36726 21-15)
Avail: CFSTI

Semiconductor reliability programs can be used to evaluate products, to determine design margins, to set specification limits, to evaluate process changes, and to determine the extent and types of programs for control of product families. This paper emphasizes the need for careful experimental design in order to meet program objectives in an economical manner. Program design elements such as parameter measurements, control of the measurements, types of stress tests, levels of stress, and some of the techniques of analyzing the data to be generated are described. The goals of reliability evaluations are discussed, and a comparison program is developed which could be utilized by a manufacturer to assess the effects of a proposed process change. Author

N69-36814# Pennsylvania State Univ., University Park. Materials Research Lab.
RELATION OF MECHANICAL PROPERTIES OF THE STRUCTURE OF IONIC SOLIDS Quarterly Report, 1 Sep.–30 Nov. 1968
K. Vedam and R. E. Newnham Watertown, Mass. Army Mater. and Mech. Res. Center 20 Dec. 1968 13 p refs
(Contract DA-19-066O-AMC-325(X))
(AD-688185; AMMRC-CR-68-07/10; QR-10) Avail: CFSTI CSCL 20/2

The elastic constants of Durango fluorapatite have been determined using the ultrasonic pulse superposition method. Room-temperature adiabatic stiffnesses are given. Comparison is made with measurements on bones and teeth. Author (TAB)

N69-36907 Missouri Univ., Columbia.
COLOR CENTERS IN MAGNESIUM OXIDE
Roger Lee Kroes (Ph.D. Thesis) 1968 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-3394

Single crystals of MgO were additively colored in magnesium metal vapor. These crystals were heated to temperatures of from 1600°C to slightly over 1800°C, and at magnesium vapor pressures up to approximately 4000 torr. The resultant change in the room temperature optical absorption spectrum showed an asymmetric absorption band which peaked at 4.96 eV and had a width at half maximum of 0.8 eV. Analysis of this absorption band indicated that it was due to the creation of oxygen ion vacancies which trapped two electrons forming an F' center. The activation energy for this process was found to be +1.53 eV. Magnesium oxide crystals additively colored in calcium metal vapor were found to produce essentially the same absorption spectrum as those heated in magnesium except that a much higher coloration was achieved for a given vapor pressure. The X-irradiation of additively colored MgO crystals, both at room temperature and liquid nitrogen temperature, did not produce any significant change in their optical absorption spectra. Dissert. Abstr.

N69-36909 Oklahoma Univ., Norman.
AN INVESTIGATION OF CHARGE TRANSPORT MECHANISMS IN EVAPORATED OXIDE FILMS ON ETCHED SILICON SURFACES
David Arlen Todd (Ph.D. Thesis) 1968 48 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-1996

Four possible conduction mechanisms in a metal-oxide-semiconductor structure were studied: (1) tunneling from metal to semiconductor; (2) Schottky or Richardson emission over a potential barrier; (3) conduction via electron trap sites located within the oxide layer and on the surface of the semiconductor; and (4) breakdown mechanisms (Zener or avalanche) in the oxide layer. The theoretical voltampere characteristics along with charge storage and ac capacitance features of the several mechanisms are presented. Methods of preparing an aluminum-evaporated silicon monoxide-etched silicon structure are presented, and details of experimental measurements of ac and dc characteristics are discussed. Experimental results indicate that the primary charge transport mechanism through evaporated oxide films is controlled by the large electron trap density in the oxide. Even for very thin oxide films, where tunneling currents should be present, the electrical conduction takes place through trapping sites in the oxide and on the surface of the semiconductor. Evidence of electron trapping sites in the structure investigated was obtained from time-dependent capacitance and conductance measurements. Dissert. Abstr.

N69-36922*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SOLID STATE IMAGE SENSOR RESEARCH Final Technical Report
W. E. Davern, R. E. Glusick, C. W. Kim, M. E. Seymour, and R. D. Stewart Mar. 1969 98 p ref
(Contract NAS12-131)
(NASA-CR-86231) Avail: CFSTI CSCL 20L

Fifty element linear arrays of InAs photodiodes were developed for radiation sensing in the 1-3 micron wavelength region. Monolithic fabrication techniques and controlled surface treatment have reduced leakage currents to 5×10^{-9} amps/cm^2. Device design, fabrication techniques, and optical and electrical measurements are described. In addition, PbSnTe detectors were evaluated for application to 8-14 micron radiation sensing. This ternary compound offers a potentially higher operating temperature than doped Ge and a greater compositional uniformity than HgCdTe. Read-out of the signal requires that high-sensitivity preamplifiers be used. Direct amplifications and charge-storage modes were evaluated for optimum system performance. A 50-channel amplifier-multiplexer was built. Author

N69-37054# Delaware Univ., Newark. Dept. of Physics.
DESORPTION OF OXYGEN AND ITS EFFECTS ON THE ELECTRICAL PROPERTIES OF CdS SINGLE CRYSTAL PLATELETS
Rudolf Schubert (Ph.D. Thesis) Jun. 1969 90 p refs Sponsored Jointly by US Navy and US Army
(AD-688904; TR-33) Avail: CFSTI CSCL 20/2

Oxygen effects on CdS single crystal platelets are shown to manifest themselves in several ways and allow one to divide the crystals into two basic classes. Thermally stimulated desorption studies, with a sensitive partial pressure analyzer in ultra high vacuum, show that there are several layers of monatomic oxygen adsorbed on the crystal surface for the assumption that the real surface equals the geometrical surface. A sensitization and compensation model is shown to account quantitatively for the observed changes in photoconductance and rising Fermi level due to oxygen desorption. In this case some of the surface states which originally contained adsorbed oxygen act as sensitization centers after the oxygen is desorbed, whereas others act as charge compensation centers. On the other hand a model which is based on the adsorbed oxygen causing fast surface recombination is shown to be incapable of accounting for the rising Fermi level. Author (TAB)

N69-37084# Pennsylvania State Univ., University Park. Materials Research Lab.
STRUCTURAL STUDY OF Ti SUB 5 O SUB 9
L. K. Keys *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 273-276 refs (See N69-37063 21-06)
(Contract AT(30-1)-2851)
Avail: SOD $4.00

The crystal structure of Ti_5O_9 can be described as being built up of rutile type elements, with a complicated arrangement of the metal atoms in the interstitial positions of the lattice formed by the packing of anions. More explicitly the crystal structure of Ti_5O_9 is triclinic. A magnetic susceptibility study has shown it to resemble antiferromagnetic behavior. The magnetic susceptibility shows a complex dependence on the inverse of the temperature above the indicated Neel temperature. Results of an electron spin resonance study from 77°K to 160°K indicates a narrow peak with a g-value of 1.98 ± 0.02. The magnetic susceptibility appears to confirm the existence of the cation-cation interactions expected for such a shear structure. The electron spin resonance study indicates an anomalous behavior which is probably related to the effects of the stacking fault; however, its interpretation is not as clearly evident. A.L.

N69-37085# Pennsylvania State Univ., University Park. Materials Research Lab.
SIGNIFICANCE OF WEIGHTING SCHEMES IN AN ANISOTROPIC LEAST SQUARES REFINEMENT OF RUBY

J. W. Mc Cauley and G. V. Gibbs *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 277–282 refs (See N69-37063 21-06)
(Contracts ARPA SD-132; ARPA DA-49-083; ARPA OSA-3140)
Avail: SOD $4.00

The structural and vibrational parameters of a synthesized ruby containing 5.2 mole percent Cr_2O_3 were refined by least squares and Fourier methods employing 3D counter diffractometer intensity data. The effect of various absolute and relative weighting schemes on the final parameters was subsequently examined in several least squares refinements using 66 intensities. Absolute weights corresponding to systematic and anisotropic errors inherent in the intensity measurement were estimated in two ways: (1) from the standard deviation of averaged symmetry equivalent reflections, and (2) from the range estimate. It is apparent from the analysis that weighting schemes must not be used indiscriminately in least squares refinements if physically meaningful information regarding anisotropic vibrational states of atoms is desired. Any relative scheme which weights the data according to an empirical function of the magnitude of Fo values, regardless of which Fo is the most precise, must in fact erroneously bias the temperature factor calculation. A.L.

N69-37086 Army Electronics Command, Fort Monmouth, N.J. Inst. for Exploratory Research.
THE CRYSTAL STRUCTURE OF C SUB 8 AL SUB 2.1 B SUB 51 (AlB SUB 10)
A. J. Perrotta, W. D. Townes, and J. A. Potenza *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 283–286 refs (See N69-37063 21-06)
Avail: SOD $4.00

A detailed discussion of the crystal structure of $C_8Al_{2.1}B_{51}(AlB_{10})$ is presented. A.L.

N69-37087# Oak Ridge National Lab., Tenn. Solid State Div.
LATTICE DYNAMICS OF MOLECULAR SOLIDS
Gerald Dolling *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 289–314 refs Sponsored by AEC (See N69-37063 21-06)
Avail: SOD $4.00

A discussion is presented to show how the dynamical theory for a relatively simple solid is treated, to indicate the difficulties which arise in the study of crystals of more complicated structure, and to discuss various methods which have been developed to avoid or overcome these difficulties. The interactions are represented by disposable parameters or force constants, whose values are obtained by comparison with appropriate physical properties. The Born-von Karman theory is outlined along with certain extensions which have been made in order to describe the lattice dynamics of a simple alkali halide. Experimental results and theoretical calculations for lithium fluoride, sodium nitrite, hexamethyl-enetetramine, naphthalene, and anthracene are presented. Author

N69-37089# National Research Council of Canada, Ottawa (Ontario). Div. of Applied Chemistry.
ABSORPTION OF LIGHT BY THE SOUND WAVES OF ORIENTATIONALLY DISORDERED CRYSTALS
E. Whalley *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 323–326 refs (See N69-37063 21-06)
Avail: SOD $4.00

The purpose of this paper is to discuss the absorption of light by orientationally disordered crystals in the acoustic branches where the Debye density of states holds. We are interested then in the absorption of light by sound waves. A detailed study of the far-infrared spectrum of ice, particularly of cubic ice (ice Ic), which is orientationally disordered, revealed features that could be identified with features in the density of vibrational states such as the *TO*, *LO*, *LA*, and *TA* maxima, the minimum between the *LO* and *LA* branches, and so on. It is assumed that the potential energy can be written as the sum of square terms of the internal coordinates. Author

N69-37091# Princeton Univ., N.J. Frick Chemical Lab.
LATTICE VIBRATIONS IN SOME SIMPLE MOLECULAR CRYSTALS
J. C. Laufer, J. E. Cahill, and G. E. Leroi *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 327–329 refs (See N69-37063 21-06)
Avail: SOD $4.00

Raman spectra of polycrystalline samples of CO_2, N_2O, $\alpha-N_2$ and $\alpha-CO$ have been obtained on a laser instrument. Several librational lattice modes have been observed and experimental frequencies are compared to theoretical calculations using a pairwise intermolecular potential consisting of a Lennard–Jones term and multipole–multipole interactions. The observed frequencies are given in the table. The spectrum of CO_2 is as predicted, showing three bands which do not correspond with the observed far-infrared results. The N_2O results are similar, giving three bands which are assigned as librations because of their strong intensity. The fact that there is no coincidence with the far-infrared spectrum strengthens this assignment and shows that appreciable mixing between librations and translations does not occur. Two strong bands were observed in N_2. Because of their intensity, and the fact that they differ in frequency from the translational motions observed in the far infrared they are assigned as predominantly librational. Only one broad, asymmetric band is observed in CO which has been assigned as a librational motion. Author

N69-37092# California Univ., Livermore. Lawrence Radiation Lab.
THE OPTICAL AND ANHARMONIC THERMAL PROPERTIES OF A DIATOMIC MOLECULAR SOLID
George E. Jelinek *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 331–334 refs Sponsored by AEC (See N69-37063 21-06)
Avail: SOD $4.00

The primitive monomolecular rhombohedral β oxygen structure with large vibrational excursions from the equilibrium configuration is used as model for describing lattice vibrations of oxygen, nitrogen, and fluorine at low temperatures. The assumed structure involves cubic close-packing of cylinders and the effects of the harmonic, cubic, and quartic potential are considered. Force constants are obtained from the two body potential between nonbonded atoms and the parameters of the potentials are evaluated from observed cohesive energies and the nearest neighbor distances of oxygen, carbon monoxide, fluorine, chlorine, bromine, and iodine. The potential energy is expanded first in terms of the parameters of a homogeneous deformation, then in terms of the nuclear displacements from their equilibrium position in the deformed structure. For both the α and β phases of oxygen, for nitrogen, and α fluorine calculated thermodynamic properties are in good agreement with experimental results. Analysis of the infrared oxygen spectra indicates that the lattice combination centered at 69 cm^{-1} is a vibration-translation combination of the type longitudinal optic + longitudinal acoustic. G.G.

N69-37093# Picatinny Arsenal, Dover, N.J.
NEUTRON SCATTERING STUDIES OF MOLECULAR VIBRATIONS IN ICE

H. Prask, H. Boutin, and S. Yip *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 335–337 refs Prepared in cooperation with MIT (See N69-37063 21-08)
Avail: SOD $4.00

An extension of the one-phonon incoherent neutron scattering theory was used to analyze neutron scattering data from a 0.3 mm thick samples of hexagonal ice at 150°K. A frequency distribution was extracted and the specific heat calculated. Results agreed with measurements, frequencies close to optical results, and distribution moments in agreement with inferred values. Author

N69-37094# Air Force Systems Command, Wright-Patterson AFB, Ohio.
INFRARED ABSORPTION STUDIES OF INTERMOLECULAR VIBRATIONS IN THE LOW FREQUENCY REGION
Neil T. Mc Devitt, R. E. Witkowski, and W. G. Fateley *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 339–341 Prepared in cooperation with Mellon Inst.
Avail: SOD $4.00

Intermolecular forces between structures and physical–chemical properties of crystals were studied by obtaining infrared spectra of their vibrational modes. Lattice vibrations were evaluated for ionic, van der Waals, and hydrogen bonds by observing lattice parameters, high pressure, and low and high temperature effects. Results from studies on various solids showed that not all lattice modes shifted with pressure and that the type of motion the atoms underwent in a specific mode may determine their sensitivity to pressure. A definite distinction between sensitivity to pressure and sensitivity to temperature seemed to exist. G.G.

N69-37096# Bristol Univ. (England). School of Chemistry.
ON THE SECOND ORDER ELASTIC CONSTANTS OF MOLECULAR SOLIDS
M. L. Klein *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 349–351 refs (See N69-37063 21-08)
Avail: SOD $4.00

In this paper we are concerned with the possible importance of anharmonic effect in the interpretation of the thermoelastic properties of molecular solids. In particular, we shall be concerned with the relationship between elastic constants determined by: (1) isothermal thermodynamic measurement; (2) velocity of ultrasound (adiabatic), and (3) slopes of phonon dispersion curves as measured by the inelastic scattering of neutrons. For a strictly harmonic solid these three measurements are equivalent and simply related to the harmonic force constants. However, in an anharmonic crystal these three quantities, in principle at least, show a different temperature dependence. Later we shall use solid Kr to illustrate the possible magnitude of these differences. Solid Kr is chosen because it is a crystal in which anharmonic effects are important, but not dominant, and this situation is likely to be common to many other molecular solids. Author

N69-37100# General Electric Co., Schenectady, N.Y. Research and Development Center.
HIGH PRESSURE CRYSTAL STRUCTURE OF METAL FREE PHTHALOCYANINE
R. S. Kirk *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 389–392 refs (See N69-37063 21-08)
Avail: SOD $4.00

Experimental attempts at definition of the molecular structure of new forms of phthalocyanine single crystals are reported. Speculation that the high pressure-produced macroscopic single crystals are related to the monoclinic structure of platinum phthalocyanine is supported by a comparison of angles and dimensions of the two. In this case, a metal-free phthalocyanine high pressure crystal form was compared to a platinum phthalocyanine crystal. M.H.E.

N69-37101# West Virginia Univ., Morgantown. Dept. of Chemistry.
X-RAY DIFFRACTION AND RADIOFREQUENCY SPECTROSCOPIC INVESTIGATION OF DIMETHYLTIN DICHLORIDE
Jack D. Graybeal and Domnic A. Berta *In* Natl. Bur. of Std. Mol. Dyn. and Struct. of Solids Jun. 1969 p 393–396 refs Sponsored by NSF (See N69-37063 21-08)
Avail: SOD $4.00

Previous nuclear quadrupole resonance (NQR) investigations have shown that there is a much larger change of the observed NQR frequency of ^{35}Cl in going from $SnCl_4$ to organotin chlorides than for comparable substitutions on other group IVA tetrahalides. This phenomenon, along with observed positive temperature coefficients for several dichlorides, indicates that there is either a large change of π-bonding or ionic character with substitution of organic groups. An NQR Zeeman study was instigated in order to determine the magnitude and direction of the principal electric field gradient (EFG) tensor components and provide additional bonding information. A knowledge of the crystal structure is necessary to specify the EFG axis directions. The combined study has provided an excellent sample of how the results of an NQR Zeeman experiment can aid in an x-ray crystal structure determination. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N69-36226*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF THE EFFECT OF ALUMINUM SIZE AND LOADING ON THE BURNING RATE OF SOLID PROPELLANTS UNDER ACCELERATION
G. Burton Northam and Wayne P. Jessee Washington Sep. 1969 26 p refs
(NASA-TN-D-5397) Avail: CFSTI CSCL 21I

Composite polybutadiene acrylic acid (PBAA) propellants were tested under centrifugal acceleration forces directed normal into the burning surface to determine the effect of aluminum particle size and aluminum mass loading on the burning rate. The weight-median diameters of the aluminum powders used in the propellants were 6, 14, and 29 μm; propellants with aluminum mass loadings of 0, 8, and 16 percent were used. The various propellant compositions were tested in a slab motor configuration with a unidirectional burning propellant grain with a 0.5-inch (12.7-mm) web thickness. Centrifuge firings were made at three pressure levels for each of six acceleration levels from static to 280g. Increasing the aluminum particle size from 6 to 29 μm resulted in increased burning rates under acceleration loads directed normal into the propellant surface. Decreasing the aluminum mass loading of the propellant decreased the acceleration sensitivity of the burning rate in the region below 150 and increased the sensitivity in the region above 150g. Author

N69-36376# Institut Franco-Allemand de Recherches, St. Louis (France).
INVESTIGATIONS ON AMMONIUM NITRATE PROPELLANTS [UNTERSUCHUNGEN AN AMMOVIUMNITRAT-TREIBMITTELN]
K. Zimmermann and W. Kegler 26 Aug. 1968 64 p refs In GERMAN; FRENCH summary
(ISL-7/68) Avail: CFSTI

Extensive numerical data and illustrations resulting from smoke and combustion studies between 1961 and 1968 with ammonium nitrate propellants are presented. The chemical composition of the propellants is specified, and ballistic data on the performance of the propellants in artillery pieces and bombs are summarized in tables. Tests were conducted to improve the chemical stability and hygroscopicity of the propellants under various climatic conditions. Moisture protection by means of films is discussed. The addition of ammonium nitrate to other propellants was investigated to determine its effectiveness in retarding the erosion mechanism. The rate of combustion of ammonium nitrate was measured in a Crawford bomb at various temperatures and at pressures up to 3000 kp/cm^2. A comparison of the tabulated results shows that the combustion velocity of ammonium nitrate is an average of 30% lower than that of other comparable double-base propellants.
Transl. by K.W.

N69-36647# Catholic Univ. of America, Washington, D.C. Stress Analysis Labs.
DEVELOPMENT OF EXPERIMENTAL STRESS ANALYSIS METHODS TO DETERMINE STRESSES AND STRAINS IN SOLID PROPELLANT GRAINS. PHOTOELASTIC ANALYSIS OF FLEXURAL WAVES IN A BAR
J. A. Clark and A. J. Durelli May 1969 30 p refs
(Contract Nonr-2249(06))
(AD-688149; Rept-19) Avail: CFSTI CSCL 20/9.2

A complete, direct, full-field optical determination of dynamic stress distributions is illustrated. The method is applied to the study of flexural waves propagating in a photoelastic, urethane rubber bar. A displacement type of transverse, dynamic loading (which has approximately the form of a decaying sine wave) is applied at one end of the bar. The loading pulse can be repeated with good precision. Individual isochromatics and isoclinics are obtained using a still camera with a short duration (0.5 microsecond) flash. A series of isochromatics have also been obtained with a Fastax high speed motion picture camera. Photoelastic data is supplemented by isopachic patterns obtained by a modified method of holographic interferometry recently developed by the authors. As an example of complete determination of stress distributions a vectorial representation of the principal stresses at one instant is given. Comparisons are made with approximate theories of flexural waves.
Author (TAB)

N69-36704# Catholic Univ. of America, Washington, D.C. Stress Analysis Labs.
DEVELOPMENT OF EXPERIMENTAL STRESS ANALYSIS METHODS TO DETERMINE STRESSES AND STRAINS IN SOLID PROPELLANT GRAINS. A MODIFIED METHOD OF HOLOGRAPHIC INTERFEROMETRY FOR STATIC AND DYNAMIC PHOTOELASTICITY
J. A. Clark and A. J. Durelli Apr. 1969 34 p refs
(Contract Nonr-2249(06))
(AD-688148; Rept-18) Avail: CFSTI CSCL 21/9.2

A simplified absolute retardation approach to photoelastic analysis is described as an alternative to the more commonly used relative retardation approach. Isochromatics and isopachics are presented as applications of the method to static and dynamic problems.
Author (TAB)

N69-36890# Naval Ordnance Lab., White Oak, Md.
EXPLOSIVE BEHAVIOR OF A SIMPLE COMPOSITE PROPELLANT MODEL
Donna Price, John O. Erkman, Robert A. Clairmont, Jr., and David J. Edwards 11 Mar. 1969 65 p refs
(AD-689353; NOLTR-69-16) Avail: CFSTI CSCL 19/4

AP/Wax mixtures were used to model a simple composite propellant. Addition of wax to the AP increased its infinite diameter detonation velocity, increased its shock sensitivity, decreased its critical diameter and its reaction zone length. The maximum of these effects occurred at about 20% wax. At this composition, the model is an explosive comparable to TNT.
Author (TAB)

N69-37034# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
EMULSIFIED FUELS CHARACTERISTICS AND REQUIREMENTS Final Report
C. M. Urban, J. N. Bowden, and J. T. Gray Fort Eustis, Va. Army Aviation Materiel Labs. Mar. 1969 102 p refs
(Contract DAAD05-67-C-0354)
(AD-688167; USAAVLABS-TR-69-24) Avail: CFSTI CSCL 21/4

A Preliminary Description of Emulsified Fuels is presented which provides essential property requirements based on knowledge developed at this and other laboratories. Many test methods were adopted, adapted, or developed as required, and tentative limits were established wherever the applicable information was available. The candidate emulsified fuel formulations, developed at the various laboratories, were evaluated at this laboratory, by the test methods of the preliminary description, in a small turbine engine and in bench turbine combustion and fuel systems.
Author (TAB)

N69-37053# Pennsylvania State Univ., University Park. Science Section.
A SELECTION RULE FOR CARATHEODORY'S MULTIPLE ENTROPIES
Robert H. Essenhigh May 1969 59 p refs
(Contract NONR-656(29))
(AD-688932; FS68-1) Avail: CFSTI CSCL 21/9

The work described in this report is an outgrowth of some theoretical studies associated with a primarily experimental program on combustion and pyrolysis of carbonaceous solids with reference to their possible use as hybrid rocket fuels. Consideration of thermodynamic equilibria associated with condensed phases indicated a need for scrutiny of the commonly accepted principles defining equilibrium; and this led to a re-examination of the entropy function with particular reference to possible physical implications of integrating denominators, other than the absolute temperature, in Caratheodorys infinite set.
Author (TAB)

N69-37057# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
THE BURNING MECHANISM OF AMMONIUM PERCHLORATE-BASED COMPOSITE SOLID PROPELLANTS
J. A. Steinz, P. L. Stang, and M. Summerfield Feb. 1969 250 p refs
(Contract NONR-1858(32))
(AD-688944; AMS-830) Avail: CFSTI CSCL 21/9.2

Theories of propellant burning are briefly reviewed in the light of previous studies of the burning behavior and flame structure of composite ammonium perchlorate (AP) propellant. Those studies showed that the granular diffusion flame (GDF) theory conforms to the known structure of the propellant flame, and is quantitatively valid for a wide class of practical AP propellants, much more so than any other theory proposed for composite propellants.
Author (TAB)

N69-37165# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Mechanical Engineering.
AMMONIUM PERCHLORATE LINEAR PYROLYSIS BY CONVECTIVE SURFACE HEATING
Robert F. Mc Alevy, III and Richard B. Cole Jun. 1969 16 p refs *Its* AIAA Paper No. 69-501
(Contract Nonr-263-(48))
(AD-689-383; TR-ME-RT-69005) Avail: CFSTI CSCL 21/9.2

Ammonium perchlorate (AP) specimens were exposed to various levels of convective surface heating at one atmosphere ambient pressure. Surface regression rates were measured and, simultaneously, surface temperatures were determined by measuring the infrared emission near 3.1 microns. These data represent the first AP linear-pyrolysis characteristics obtained by means of convective surface heating. Previously, linear pyrolysis was obtained by pressing specimens against heated plates (solid and porous) and heated wire meshes. The subject data agree with some, and disagree with other, of these previous data. The usefulness of convective surface heating and radiometric techniques are evaluated. It is demonstrated that preliminary experiments are required to support their use in linear pyrolysis studies. According to the evaluation, previous radiometric work dealing with surface decomposition is open to substantial question. It is concluded that the subject techniques are viable and offer experimental compliments to other methods, but that none of the current techniques are without substantial shortcomings. Means of incorporation of AP linear pyrolysis results into theoretical models of the propellant deflagration process are discussed. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N69-36047# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
EFFECTS OF OBLIQUE SHOCK WAVES IN THE NEAR FIELD OF ROCKET PLUMES AT HIGH VACUUM
J. Lang, C. W. Osonitsch, and T. M. Lacinski Aug. 1969 21 p refs Submitted for publication
(RM-453J) Avail: CFSTI

Rocket exhaust nozzles frequently generate internal oblique shock wave systems that propagate out into the plume. These shock waves produce severe local disturbances when they impinge on nearby surfaces and can cause near field plume properties to be substantially different from those predicted by uniform exit-plane calculations. Data from short duration tests in a detonation tube facility which simulated the IM ascent, descent, and RCS engine plumes are presented to illustrate these points. Sketches of the resulting flow fields are also shown. Author

N69-36100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUNDAMENTALS OF THEORY AND CALCULATION OF LIQUID-PROPELLANT ROCKET ENGINES, VOLUME 1
A. P. Vasilev et al Jan. 1969 300 p refs Transl. into ENGLISH of Vol. 1 of the book "Osnovy Teorii i Rascheta Zhidkostnykh Raketnykh Dvigateley" Moscow, Izd. Vyssaya Shkola, 1967 p 1-284
(AD-687618; FTD-MT-24-253-68-Vol-1) Avail: CFSTI CSCL 21/8.1

Theoretical and design principles of liquid rocket engines are presented. Extensive coverage is given to processes taking place in the combustion chamber, calculations of mixing systems, the cooling and contour calculation of the nozzles, calculation and selection of optimal parameters, turbopump and fuel feed pressurization systems, generation of the working medium for the turbine and fuel feed pressurization system, design and integration of pneumohydraulic systems for liquid rocket engines, calculation methods and selection of a liquid rocket engine parameters with a closed generation circuit of the working medium for the turbine. Basic theoretical and design principles of processes taking place in different types of liquid rocket engines are presented. The operation of main subsystems and the calculation of their characteristics are discussed. Author (TAB)

N69-36101# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUNDAMENTALS OF THEORY AND CALCULATION OF LIQUID-PROPELLANT ROCKET ENGINES, VOLUME 3
A. P. Vasilev et al Jan. 1969 287 p refs Transl. into ENGLISH of Vol. 3 of the book "Osnovy Teorii i Rascheta Zhidkostnykh Raketnykh Dvigateley" Moscow, Izd. Vyssaya Shkola, 1967 p 589-871
(AD-688685; FTD-MT-24-253-68-Vol-3) Avail: CFSTI CSCL 21/8.1

The report describes the functioning elements of liquid rocket engines and expounds basic rocket theory. TAB

N69-36246*# Aerojet-General Corp., Sacramento, Calif.
INVESTIGATION OF TWIN-SPOOL TURBOPUMP PERFORMANCE Final Report
E. K. Bair, F. X. Andrews, J. Farquhar, C. L. Harris, K. G. Kirk et al 5 Sep. 1969 425 p refs
(Contract NAS3-11231)
(NASA-CR-72540; AGC-9400-16) Avail: CFSTI CSCL 21E

The performance of a twin-spool turbopump, wherein a gas turbine coaxially drives the inducer, was investigated as part of a study to evaluate various zero net positive suction pressure (NPSP) feed systems. Steady state and transient tests were conducted in liquid hydrogen and the results were used to refine a computer program that predicts the performance of the twin-spool turbopump. In addition, the extension of the operating range at zero NPSP (as compared to conventional pumps) was investigated along with the effect of varying the inducer turbine pressure ratio. It was found that the concept is applicable to the starting requirements of either chemical or nuclear engines and that the basic mechanical concept is a workable arrangement. Author

N69-36316*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
THE PRINCIPLE CHARACTERISTICS AND DESIGN FEATURES OF R. GODDARD'S ROCKETS
I. N. Bubnev *In its* Trans. of the Tenth Sci. Conf. of the Inst. of Hist. of Nat. Sci. and Tech. Sept. 1969 p 13-23 refs (See N69-36314 21-34)
Avail: CFSTI CSCL 21H

The article presents the principal contributions of Robert Hutchings Goddard (1881-1945) in the USA in the field of liquid propellent rocket engines. The principal improvements made by Goddard were related to the combustion chamber, the system for feeding the fuel, the stabilizing system and the mass flow function. His improvements were not systematic, according to the author, because of the limited support of the US Government, and the secrecy which surrounded him. It is shown that, although Goddard's rockets lagged behind those designed in Germany in their

scale-ratio, the experimenter did make an outstanding achievement in stabilizing a rocket with jet-and air-vanes, and in using a pump-line system for feeding the fuel. Author

N69-36317*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

THE CONSTRUCTION OF AN ELECTRIC ROCKET ENGINE IN THE GAS DYNAMICS LABORATORY

L. M. Aleksandrova *In its* Trans. of the Tenth Sci. Conf. of the Inst. of Hist. of Nat. Sci. and Tech. Sep. 1969 24-30 refs (See N69-36314 21-34)

Avail: CFSTI CSCL 21C

A discussion of the design and production of the first electric rocket engine of the electrothermal type is presented. The first designs were based on the principle of exploding metal wires for the discharge. The article shows that studies are still being conducted on the problem of sources of energy for such an engine. Author

N69-36320*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

THE DEVELOPMENT AND USE OF LIQUID-PROPELLANT ROCKET ENGINES IN EXPERIMENTAL AIRCRAFT IN THE USA (1944-1953)

G. V. Skvortsov *In its* Trans. of the Tenth Sci. Conf. of the Inst. of Hist. of Nat. Sci. and Tech. Sep. 1969 p 49-57 refs (See N69-36314 21-34)

Avail: CFSTI CSCL 21H

By using liquid-propellant rocket engines (LPRE's) in high-altitude and high-speed experimental aircraft, the USA, at the cost of a great deal of effort and money, accelerated a solution to the problem of the "sound barrier", and the production of supersonic combat aircraft. Multiple experiments using LPRE's as the main engines on the experimental supersonic aircraft X-1, X-2 and D 558-II aided in the development of a reliable and powerful LPRE, the LR-99, which had a thrust of 22.6 tons and permitted studying hypersonic speeds at altitudes up to 150 km. Author

N69-36328*# National Aeronautics and Space Administration, Washington, D.C.

THE OPTIMUM HYDRAULIC CAMPING MOUNT FOR A TURBINE TOTOR

K. A. Kryukov *In its* Invest. of Vibration and Stability of Aircraft Eng. Components Aug. 1969 p 20-47 refs (See N69-36326 21-02)

Avail: CFSTI CSCL 21E

Formulated are the expressions for the critical shaft rpm of a turbine motor with hydraulic damping mount by taking into account the deformation in the direction of the frictional force, the dynamic intensification factor, the deflection, the angles of displacement of the deflections relative to the perturbing force, the unbalance force, the stresses in the shaft, and other parameters. We shall also discuss the operation of a hydraulic damping mount and shall give alternate methods for selecting optimum parameters when the oil temperature increases. Finally, we shall examine the conditions under which deformation in the direction of the frictional force can be neglected. The magnitude of the required damping resistance factor can be established from the tolerable deflection and stresses in the shaft and the magnitude of the unbalance force. Author

N69-36430# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PULSE SELECTION FOR MEASURING THE AIR FLOW RATE IN GAS TURBINE ENGINE GOVERNORS

I. V. Vlasenko 24 Feb. 1969 8 p ref Transl. into ENGLISH from Energomashinostr. (Moscow), v. 13, no. 7, 1967 p 39-40 (AD-688728; FTD-HT-23-1085-68) Avail: CFSTI CSCL 13/9

Two methods are reviewed of measuring air flow rates in gas turbine engine governors. The methods, consisting of measuring the air pressure behind the compressor and of measuring the rpm of the turbo-compressor, are analyzed and compared. Author (TAB)

N69-36680*# General Motors Corp., Indianapolis, Ind.

EXPERIMENTAL INVESTIGATION IN AN ANGULAR CASCADE SECTOR OF HIGHLY LOADED TURBINE STATOR BLADING. VOLUME 4: PERFORMANCE OF A JET-FLAPPED BLADE

James L. Bettner Washington NASA Sep. 1969 144 p refs (Contract NAS3-9404)

(NASA-CR-1423; EDR-5315-Vol-4) Avail: CFSTI CSCL 21E

A jet-flapped blade has been tested in a six-blade annular cascade, and three jet slot sizes of 0.022, 0.031, and 0.040 in. with three secondary flow rates for each slot have been investigated. The combinations of jet slot height and secondary flow rates produced a range of mean section jet momentum coefficient, $C_{\mu m}$, values of up to 0.08. The momentum coefficient is the ratio of jet-to-total momentum that exists at the blade trailing edge. Experimental results are compared with those for a plain blade designed to the same loading level as the jet-flapped blade but with greater solidity. The axial chord solidity, C_x/s, for the plain blade was 1.29, whereas it was only 1.18 for the jet-flapped blade. Flow visualization results revealed that flow separation was essentially prevented all the way to the trailing edge region of the center blades of the cascade. Author

N69-36785# Bell Aerosystems Co., Buffalo, N.Y.

ONE-MAN PROPULSION DEVICES AND THEIR APPLICATION ON EARTH AND IN SPACE

Don R. Ostrander *In* School of Aerospace Med. Biosstronaut. and the Exploration of Space Nov. 1968 p 133-152 refs (See N69-36776 21-04)

Avail: CFSTI

The development of devices during the 1950's and early 1960's is traced, and the three different design approaches to such simple propulsion systems are identified. These are: (1) flying platforms, which the pilot controls by shifting his weight; (2) one-man helicopters; and earth and space rocket-powered propulsion systems in a variety of configurations. Mention is made of tether test rigs, small rocket lift devices, jet-powered individual life devices, flying chairs, and the POGO vehicle. The use of such devices for lunar landing missions involving surface exploration, emplacement of scientific instruments, transportation into inaccessible areas, remote sensing, surveying/mapping, and rescue operations is treated. Finally, manual, orbital maneuvering requirements are briefly described, for which the type of device employed depends upon range, time available for maneuvering, and type and amount of instrumentation and support equipment available. A.C.R.

N69-36844*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN ELECTRON BOMBARDMENT THRUSTER OPERATED WITH A CUSPED MAGNETIC FIELD

Allen J. Cohen Washington Sep. 1969 21 p refs (NASA-TN-D-5448) Avail: CFSTI CSCL 21C

The performance of two 20-centimeter-diameter electron bombardment thrusters with an axial magnetic field and a superimposed cusp magnetic field was experimentally determined. The thruster lengths were 20 and 10 centimeters, respectively. The

cusp field was added to suppress the anomalous diffusion phenomenon found in the discharge chamber of the thruster. Discharge performance and discharge noise measurements were obtained. Anomalous diffusion appeared to be suppressed by the addition of the cusp field; however, thruster performance was not enhanced. Author

N69-36847*# Tech Development, Inc., Dayton, Ohio.
DEVELOPMENT OF A HYDROGEN-BURNING ANNULAR COMBUSTOR FOR USE IN A MINIATURE GAS TURBINE ENGINE
Mackenzie Burnett [1969] 39 p ref
(Contract NAS1-7261)
(NASA-CR-66362) Avail: CFSTI CSCL 21E

A hydrogen-burning annular combustor for use in a miniature gas turbine engine for wind tunnel test programs was developed. The burner was designed for a 4:1 pressure ratio engine, 3.6 inch inlet diameter using 1.87 pounds of air per second and an average temperature rise of 1500°F. The annular burner successfully demonstrated an average temprature rise of 1500°F. minimum and showed little deterioration after a 5 hour 24 minute endurance test at the above conditions. Author

N69-36882*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A COMPUTER PROGRAM FOR COMPOSING COMPRESSOR BLADING FROM SIMULATED CIRCULAR-ARC ELEMENTS ON CONICAL SURFACES
James E. Crouse, David C. Janetzke, and Richard E. Schwirian Washington Sep. 1969 84 p refs
(NASA-TN-D-5437) Avail: CFSTI CSCL 01A

A blade element layout method is developed and combined with a stacking procedure in a computer program to compose a complete compressor blade. The layout method simulates the circular arc type blade element on a cone with the preservation of the constant rate of angle change. The computer program is capable of handling a multiple circular arc blade element. It calculates blade corss section coordinates and geometric properties for mechanical design and stress analysis. Author

N69-36893# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN EXPERIMENTAL INVESTIGATION OF THE COOLING AIR FLOW IN THE CHANNEL UNDER THE ROTATING VANE FLANGES OF GAS TURBINE ROTORS
E. P. Dyban et al 31 Jan. 1969 15 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), v. 11, no. 1, 1968 p 83 89
(AD-688144; FTD-HT-23-858-68) Avail: CFSTI CSCL 21/5

In the cooling of gas turbine rotors by passing air through the clearances in the blade roots, a substantial portion of heat transfer (up to 55%) takes place in a channel provided at the blade root. The purpose of the investigation was to determine the hydraulic resistance coefficients for a slit-type clearance and for a channel provided at the top section of the blade root. Since the hydraulic resistance coefficients are applicable only in the investigated range of geometrical dimensions and for the determining parameters, additional studies should be conducted to more accurately determine the air flow. It is desirable to increase the variation range of the split and the channel and to study other configurations. Author (TAB)

N69-36897*# Battelle Memorial Inst., Columbus, Ohio.
TECHNIQUES FOR FABRICATING ROCKET ENGINE COMPONENTS CONTAINING INTRICATE FLOW CHANNELS Final Report
A. N. Ashurst, M. Goldstein, and M. J. Ryan 1 Aug. 1969 202 p ref
(Contract NAS3-11189)
(NASA-CR-72588) Avail: CFSTI CSCL 21H

Powder metallurgy techniques were developed to fabricate simulated rocket engine components having intricate internal flow channels. To demonstrate these techniques, two simulated components of different and complex design were fabricated. One consisted of a copper baffle component of the film and convection cooling design concept. The other component was a nickel injector having a shower head design with fuel and oxidizer ports separated at the injector face. The components were fabricated by consolidating power around compatible and selectively leachable tooling using the hot-isostatic-compaction process. The dimension, alignments, and contours of the tooling representing the internal flow channels were maintained with high precision during powder densification and bonding. The tooling was removed solely by chemical dissolution; no machining other than to expose the tooling at the surface of the components was required. Author

N69-36932*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF JET VELOCITY AND AXIAL LOCATION OF NOZZLE EXIT ON THE PERFORMANCE OF A TWIN-JET AFTERBODY MODEL AT MACH NUMBERS UP TO 2.2
Bobby Lee Berrier and Frederick H. Wood, Jr. Washington Sep. 1969 80 p refs
(NASA-TN-D-5393) Avail: CFSTI CSCL 21E

The twin-jet afterbody model using two balances to measure thrust-minus-afterbody drag, and afterbody drag separately at static conditions and at Mach numbers up to 2.20 at a constant angle of attack of 0° was studied. A high pressure air system was used to simulate the nozzle flow at jet total-pressure ratios up to 22.0. All configurations had identical nondimensional area distributions. The results indicate that performance was generally increased by moving the jet exits to the extreme aft end of the afterbody for Mach numbers up to 1.30. The configurations utilizing nozzles with low exit velocity (convergent nozzles) had lower afterbody drag than configurations utilizing nozzles with higher exit velocity (convergent-divergent nozzles) at most test conditions. Author

N69-36984# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUNDAMENTALS OF THEORY AND CALCULATION OF LIQUID-PROPELLANT ROCKET ENGINES, VOLUME 2
A. P. Vasilev et al 3 Jan. 1969 308 p refs Transl. into ENGLISH of the book "Osnovy Teorii i Rascheta Zhidkostnykh Raketnykh Dvigatelei" Moscow, v. 3, 1967 p 285-588
(AD-688729; FTD-MT-24-253-68-vol-2) Avail: CFSTI CSCL 21/8.1

The report presents theory and calculations of mechanics involved in operation of a liquid rocket engine. TAB

N69-36986*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MULTISTAGE COMPRESSOR SIMULATION APPLIED TO THE PREDICTION OF AXIAL FLOW INSTABILITIES
Ross G. Willoh and Kurt Seldner Washington Sep. 1969 27 p refs
(NASA-TM-X-1880) Avail: CFSTI CSCL 21H

A simulation model for the one-dimensional steady state and dynamic performance of an axial flow compressor is presented.

The modeling technique is applied to the eight stage J 85-13 compressor. It is shown that the simulation stability boundary coincides with the compressor stall line. Analytical and experimental results are presented and compared. Author

N69-37046# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.
DESIGN AND EVALUATION OF A HIGH-TEMPERATURE RADIAL TURBINE, PHASE 1 Final Report, 18 Jul. 1967 – 30 May 1968
Glenn S. Calvert and Ulo Okapuu Jan. 1969 279 p ref
(Contract DAAJ02-68-C-0003)
(AD-688184; PWA-FR-2858; USAAVLABS-TR-68-69) Avail: CFSTI CSCL 21/5

The report describes the work accomplished in the first phase of a two-phase, two-year program that involves the design and testing of a single-stage, high-work radial inflow turbine. This turbine will be typical of one required for advanced gas turbine engines employing high cycle pressure ratios and high turbine inlet temperatures. The objectives of Phase I were to establish a preliminary turbine design, to confirm the preliminary design through cold-flow tests, and to conduct a fabrication study. The Phase I final preliminary turbine design is the result of iterative aerodynamic-structural-heat transfer analyses. The final selections of number of nozzle vanes, number of rotor blades and rotor cooling air ejection method were confirmed and supported by cold-flow tests. The fabrication study showed some material property problems which require additional investigation. Author (TAB)

N69-37123# Harry Diamond Labs., Washington, D.C.
DESIGN AND THEORY OF OPERATION-SAFETY-IGNITION DEVICE FOR APPLICATIONS TECHNOLOGY SATELLITE ROCKET MOTOR
Edward N. Freeman Nov. 1968 61 p refs
(AD-688137; HDL-TM-69-3) Avail: CFSTI CSCL 19/7

This report describes and illustrates the design and operation of a safety-ignition device (SID) that was developed for use with a 750-lb solid-propellant apogee rocket motor. This device, used in combination with the Applications Technology Satellite for NASA, is primarily intended to prevent ignition of the rocket motor during ground handling and prelaunch operations, and in orbital flight provided reliable ignition of the apogee rocket motor with a high degree of safety and operational reliability. Author (TAB)

N69-37132# Solar, San Diego, Calif.
MECHANISMS OF SAND AND DUST EROSION IN GAS TURBINE ENGINES Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1969
C. E. Smeltzer, M. E. Gulden, and W. A. Compton 31 Mar. 1969 73 p refs
(Contract DAAJ02-68-C-0056)
(AD-688187; RDR-1625-3; QTPR-3) Avail: CFSTI CSCL 21/5

Dust erosion damage of military gas turbines is a serious problem in many current service areas. The subject program is designed to gain an improved understanding of the various mechanisms of dust erosion, as a basis for possible future development of turbine materials with improved innate erosion resistance. The experimental program is organized to evaluate the relative importance of erosion influencing variables introduced by the carrier gas, the dust suspension and the target materials themselves. The report describes the following functional tasks: (1) a literature survey and data review, (2) the execution of the erosion test program, including the design and construction of special test equipment, and (3) the analysis of erosion data and development of physical and mathematical models to define erosion mechanisms. Author (TAB)

N69-37158# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Research Lab.
SUSTAINED SUPERSONIC COMBUSTION IN THE LABORATORY UNDER LOW DENSITY CONDITIONS Final Report
Robert G. Dunn, James E. Drewry, and Norman E. Scaggs 6 Mar. 1969 38 p refs Presented at the Conf. on Airbreathing Propulsion for Advanced Missiles and Aircraft, San Diego, Calif, 4-6 Mar. 1969
(AD-689393; ARL-69-0035) Avail: CFSTI CSCL 21/2

An investigation of supersonic combustion simulating conditions anticipated in propulsive systems for high altitude, high Mach number flight is described. A unique test facility in operation at the Aerospace Research Laboratories has the capability of simulating supersonic combustion conditions for flight Mach numbers near 12. The facility is considered unique because of its capability of providing conditions under which supersonic combustion can occur at low densities (1-4 psia) with diffusive mixing and with combustion resulting from auto-ignition. Experiments have been conducted with injector/combustor configurations to evaluate the ignition mechanism for axisymmetric streams of hydrogen and air and to evolve a combustion chamber design suitable for experimental study of sustained supersonic combustion. In a parallel theoretical phase, a numerical analysis of the combustion chamber flow field has been made by high speed computer; a parametric study of supersonic combustion in the diffusive hydrogen-air flow field over an air-jet Mach number range of 1.5 to 2.5 and a static pressure range of 1 to 3 psia was accomplished. Experimental data to-date have conclusively established the occurrence of sustained supersonic combustion in the diffusive hydrogen-air flow field at combustor entrance static pressures near 2.5 psia. Author (TAB)

N69-37168# Sunstrand Aviation-Denver, Denver, Colo.
EFFECT OF PRESSURE RATIO ON THE PERFORMANCE OF SUPERSONIC TURBINE-NOZZLES Summary Report
Robert E. Barber (Barber-Nichols Eng. Co.) Barber-Nichols Eng. Co. 1967 44 p refs
(Contract N00014-66-C-0204)
(AD-689384; AER-486) Avail: CFSTI CSCL 21/5

The object of the study was to obtain information to improve the off-design performance of supersonic turbine nozzles. Results show that contoured nozzles provide the best performance for turbines which operate at near design pressure ratios or at greater-than-design pressure ratios. For operation at pressure ratios below design, the conical or plug types are superior. The free expansion nozzles generally produce inferior performance as compared to the other types. Axial spacing between nozzle and rotor had little effect on off-design performance. This analysis together with limited test data indicates that the gas ratio of specific heats has a strong effect on off-design nozzle performance. The indication is that performance may be greatly reduced when operating with gases with low ratios of specific heat. The design point performance, however, does not appear to be affected. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N69-38209*# California Univ., Berkeley. Space Sciences Lab.
AURORAL MICROPULSATION INSTABILITY Technical Report
F. V. Coroniti and C. F. Kennel [1969] 45 p refs *Its* Ser. 10, Issue 38
(Contract NASw-1400; Grants NGL-05-003-012; NGR-05-007-116; Contract AT(11-1)-34; Grants NSF GP-6817; Nonr(G)-4756-01)
(NASA-CR-105597) Avail: CFSTI CSCL 04A

In this paper a drift instability of Alfven waves driven by the sharp electron thermal gradient at the inner edge of the electron plasma sheet is described. The analysis predicts a localized instability with wavelengths perpendicular to the magnetic field comparable with an ion cyclotron radius and parallel wavelengths comparable with the length of field lines. The fastest growing wave should have an ≈ 10 second period, consistent with observations of Pi 1 micropulsations observed during substorms. Author

N69-38232*# California Univ., Berkeley. Space Sciences Lab.
ELECTRON PRECIPITATION PULSATIONS
F. V. Coroniti and C. F. Kennel [1969] 35 p refs *Its* Ser. 10, Issue 37
(Grant NGL-05-003-012)
(NASA-CR-105652) Avail: CFSTI CSCL 04A

When high frequency wave turbulence is present, low frequency micropulsations can strongly modulate the high frequency wave amplitudes, leading to finite amplitude pulsations in the loss rate of energetic electrons from the magnetosphere, micropulsation amplitude is small. An extremely idealized model suggests that the precipitation modulation depends exponentially on the micropulsation amplitude, when the micropulsation period is less than the electron precipitation lifetime. Author

N69-38249*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
LOW-ENERGY PROTON (0.6 LESS THAN OR EQUAL TO E LESS THAN OR EQUAL TO 50 keV) OMNIDIRECTIONAL INTENSITY CONTOURS IN THE EARTH'S OUTER RADIATION ZONE AT THE MAGNETIC EQUATOR
L. A. Frank and H. D. Owens Jul. 1969 30 p refs
(Contract NAS5-2054; Grant NGL-16-001-002; Contract Nonr-1509(06))
(NASA-CR-105654; Rept-69-32) Avail: CFSTI CSCL 04A

Observations of low energy proton intensities within seven selected energy bandpasses spanning the energy range $0.5 \leq E \leq 50$ keV are summarized in L-value versus time diagrams for the period 10 June through 23 July 1966. These contours of omnidirectional, differential proton intensities were calculated via measurements of the directional, differential spectrums of the protron intensities with a sensitive electrostatic analyzer array borne on the earth satellite OGO 3 at mid- and low latitudes in the outer radiation zone and are normalized to a geomagnetic latitude 0° (magnetic equator). These L-versus-time diagrams provide a compact, useful summary of these unique observations of proton intensities over L-values ranging from ≈ 3.0 to 12 and promote further insight into the morphological features of one of the most dynamically important components of magnetospheric plasma. Author

N69-38250*# Techtran Corp., Glen Burnie, Md.
ANALYSIS OF POSSIBLE EFFECTS CAUSED BY MAGNETIC PARTICLES IN SPACE
L. I. Dorman et al 1968 36 p refs Transl. into ENGLISH from Kosmich. Luchi (USSR), no. 7, 1965 p 178-196
(Contract NAS5-14828)
(NASA-CR-105611) Avail: CFSTI CSCL 04A

The nature of the scalar magnetic charge on the neutrino and the ramifications of a charge on astrophysical phenomena are investigated. Proof that conclusions from Dirac's theory do not apply to this value is offered. Mathematical analysis is directed to the estimation of magnetic charge of the neutrino on the basis of ionization cross section, the movement of a magnetic particle in homogeneous magnetic fields, the bremsstrahlung of a magnetic particle in an external electromagnetic field, and the movement of a magnetic particle in the field of the terrestrial magnetic dipole. Comparisons to past theory are made. M.H.E.

N69-38263*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE INTERPRETATION OF COSMIC X-RAY AND GAMMA RAY SPECTRA. PART 1
J. I. Trombka Aug. 1969 29 p refs Submitted for publication
(NASA-TM-X-63844; X-641-69-357) Avail: CFSTI CSCL 04A

It is suggested that changes in the slope of a measured distribution may be explained partially by the effect of the measurement process itself. A method which allows the determination of both the pulse height spectrum from a known photon spectrum, and the photon spectrum from a measured pulse height spectrum was developed. Information derived from these two spectra differs significantly. For example, if, using a 3" × 3" NaI(Tl) detector, we attempt to measure a photon differential energy spectrum characterized by a $N(E) = E^{-1.8}\,dE$ distribution, we obtain a pulse height spectrum with a number of breaks in slope: a −1.5 slope in the energy region up to 80 keV, a −1.7 slope in the energy region up to 300 keV, and a slope of −2.3 from .3 MeV to 2 MeV. The technique for deriving the photon spectra from the measured pulse height spectra eliminates the effects of instrumental response, and further allows for meaningful comparison with data from different detectors. Author

N69-38434*# Environmental Science Services Administration, Boulder, Colo. Space Disturbances Lab.
EARLY DETECTION OF A SOLAR FLARE: A STUDY OF X-RAY, EXTREME ULTRAVIOLET, H-ALPHA, AND SOLAR RADIOEMISSION FROM SOLAR FLARES
R. F. Donnelly Jul. 1968 47 p refs
(NASA Order H-42710-A)
(NASA-CR-105729; ERL-81-SDL-2) Avail: CFSTI CSCL 04A

Solar X-ray, extreme ultraviolet, $H\alpha$, and radio emission were studied to determine what solar radiation is best suited for an automatic flare alarm system aboard a satellite for the detection of the start of a solar flare. Although hard X-rays ($\lambda << 1$ Å), centimeter-wavelength solar radio bursts, and flashes at certain EUV wavelengths usually have faster rise times and peak earlier than soft X-rays in the 2 to 16 Å range, the data available to date show that on the average the start time of the 2 to 16 Å X-rays occurs earlier than the start times for these other types of data. The early start times and large percentage increase of 2 to 16 Å X-rays make this radiation the best suited for the automatic detection of solar flares. Author

N69-38588*# Physical Research Lab., Ahmedabad (India).
SHORT PERIOD FLUCTUATIONS OF COSMIC RAY INTENSITY AT GEOMAGNETIC EQUATOR AND THEIR SOLAR AND TERRESTRIAL RELATIONSHIP
M. S. Dhanju and V. Sarabhai 9 Mar. 1969 23 p refs Submitted for publication
Avail: CFSTI

Using power spectrum analysis on the mu meson intensity records of a high counting rate instrument (10^8 counts per minute) operated at Chacaltaya, Bolivia, it was possible to identify cosmic

ray fluctuations of 16 and 27 cycles per hour. These frequencies were found at a 99% level of significance in the average of 1034 three-hourly samples extending from Nov. 1965 to June 1966. Comparison with Pioneer VI measurements indicates that the magnetosheath field at a distance of about 10 earth radii and the interplanetary magnetic field, show peaks in spectral density which correspond closely with peaks in muon intensity. Magnetic field measurements conducted in the magnetosphere by Explorer VI, Explorer XII, and ATS-1 show similar oscillations. The integrated power of cosmic ray oscillations in the frequency range of 6 to 30 cycles per hour at various periods and its solar-terrestrial relationship is examined. Author

N69-36857*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE COSMIC GAMMA RAY SPECTRUM NEAR ONE MeV OBSERVED BY THE ERS-18 SATELLITE
James I. Vette, Duane Gruber (Calif. Univ., La Jolla), James L. Matteson, (Calif. Univ., La Jolla), and Laurence E. Peterson (Calif. Univ., La Jolla) Aug. 1969 12 p refs Presented at the IAU Symp. no 37 on Non-Solar and Gamma-Ray Astronomy, Rome, 8-10 May 1969
(NASA-TM-X-63641; X-601-69-344) Avail: CFSTI CSCL 04A

New data on the total, or omnidirectional, cosmic ray flux in the 250 keV to 6 MeV range, obtained by the ERS-18 satellite, are reported. Flux in this energy range up to 2 MeV was confirmed up to .5 MeV and extended to lower energies by a series of rocket and balloon measurements. Observations at higher energies is important because of recent detection of galactic 100 meV gamma rays. The results show cosmic gamma rays above 1 MeV were measured, but lack sufficient measurements to support the find. Author

N69-36884*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PHOTOELECTRON FLUX AND PROTONOSPHERIC HEATING DURING THE CONJUGATE POINT SUNRISE
B. C. Narasinga Rao and E. J. R. Maier Aug. 1969 22 p refs Submitted for publication
(NASA-TM-X-63655; X-615-69-361) Avail: CFSTI CSCL 04A

Selected Explorer 31 data have been studied to establish the extent of protonospheric heating by the onset of photoelectrons from the conjugate ionosphere. Observations made during low latitude passes at altitudes above 2000 km have been analysed to determine the electron and ion temperatures and the flux of photoelectrons for the periods when one foot of the field line is in darkness while the other is undergoing sunrise. In the night hemisphere there is an increase in electron temperature from about 1500 °K to 3500 °K and in ion temperature from about 1500 °K to 3000 °K and a simultaneous increase in suprathermal flux from about 2×10^7 el. cm^{-2} sec^{-1} to 18×10^7 el. cm^{-2} sec^{-1} for electrons of energies greater than 3.7 ev. Theoretical calculations of the energy and flux degradation of the photoelectrons along the field line are made and compared with the observations. Using calculated photoelectron energy loss as the energy input to the ambient plasma and using the steady state heat conduction equation, the electron temperature profile along the field line is calculated. Author

N69-36888# Auroral Observatory, Trouso (Norway).
THE ELECTRON CONTENT IN THE POLAR F-REGION Progress Report, 1 Nov. 1967–31 Oct. 1968
Ove M. Bratteng and Jon Frihagen 20 Feb. 1969 43 p refs
(Contract F61052-67-C-0020)
(AD-688221; PR-8; SR-2; AFCRL-69-0179) Avail: CFSTI CSCL 4/1

Some results of electron content measurements in the polar F-region are presented. There is an enhancement of electron content close to local geomagnetic noon in the latitude interval 78 - 80N. There are indications of a maximum in electron content close to 2000 UT at 78N in winter. Total electron content variations with geomagnetic activity is unclear. It seems that connected with micropulsation events there is almost always a rapid and large increase in electron content. Author (TAB)

N69-36891*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRIMORDIAL COSMIC-RAY SOURCES
F. W. Stecker Aug. 1969 10 p refs Submitted for publication
(NASA-TM-X-63658; X-641-69-377) Avail: CFSTI CSCL 04A

New gamma-ray observations have provided what may be evidence for primordial cosmic-ray sources existing out to red shifts of the order of 100. These sources, here called protars, may be galaxies and quasars in their initial stages of formation. They may have provided the basic energy source for ionizing the intergalactic gas. Author

N69-36712# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
BASJE CERENKOV LIGHT EXPERIMENT Final Report
Hale V. Bradt, Allen S. Krieger, and Saul A. Rappaport 14 May 1969 37 p refs Submitted for publ.
(Contract F44620-67-C-0020)
(AD-688237; AFOSR-69-1319TR) Avail: CFSTI CSCL 4/1

The experiment was designed to measure the characteristics of the Cerenkov light in extensive air showers, and to derive information about the primary composition. The research indicates that the chemical composition of primary cosmic rays up to 10 to the 16th power eV is mixed much as it is at lower energies, approximately 10 to the 12th power eV. TAB

N69-36810*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STATISTICAL MECHANICS OF SUPERNOVAE
Frank C. Jones Sep. 1969 18 p refs Submitted for publication
(NASA-TM-X-63662; X-641-69-401) Avail: CFSTI CSCL 04A

In most treatments of the supernova origin theory of cosmic rays, average values of such observables such as cosmic ray flux, bulk streaming velocity, total energy, etc., are calculated (or estimated) and compared with observation to determine the parameters of the theory. In this investigation the variables describing the supernova injection event (position, time, etc.) are considered to be random variables and that our galaxy is a sample from an ensemble of galaxies. in this manner one can, in principle, calculate all higher moments of the cosmic ray observables. It turns out that an important parameter may be derived for any particular model of cosmic ray transport. If a single supernova event fills an effective volume with cosmic rays for a time and there are n supernova events per unit time per unit volume on the average, the quantity becomes essentially an inverse discreteness parameter in the sense that when it is large fluctuations are relatively unimportant, but when it is small fluctuations can dominate the situation. For currently considered models of our own galaxy the situation appears to be borderline. Author

N69-36991*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CO-ROTATING MODULATIONS OF COSMIC RAY INTENSITY DETECTED BY SPACECRAFTS SEPARATED IN SOLAR AZIMUTH

V. K. Balasubrahmanyan, E. C. Roelof, R. P. Butaka. (Southwest Center for Advanced Studies) and R. A. R. Palmiera Aug. 1969 17 p refs Presented at 11th Intern. Conf. on Cosmic Rays, Budapest.
(NASA-TM-X-63654; X-611-69-348) Avail: CFSTI CSCL 04A

The daily cosmic ray intensity from the IMP-C (Explorer 28) Geiger-counter monitor (Ep $\geq$ 50 MeV) and Pioneer 6 scintillation telescope (Ep $\geq$ 7.5 MeV) were analyzed by correlation functions. When the two spacecrafts are close to each other, the cross-correlation function agreed closely with the auto-correlation function of either detector, showing that both detectors were responding comparably and reliably to cosmic ray fluxes; when separated by $\approx 50^{\circ}$, the detector variation rates appear to be mainly due to galactic cosmic rays. Solar flare contributions $\geq$ 7.5 MeV were eliminated from the Pioneer 6 data by regression analysis using low energy rates (7.5 MeV $\leq$ Ep $\leq$ 44 MeV). It is proposed that there are numerous long-lived regions of modulated cosmic ray flux following the general spiral configuration of the interplanetary magnetic field as the field structure co-rotates with the sun. Author

N69-37042# Lund Univ. (Sweden). Dept. of Physics.
HEAVY PARTICLES IN PRIMARY COSMIC RADIATION. Final Scientific Report, 1 Jul. 1966 – 30 Apr. 1969
Sten. Von Friesen 28 Apr. 1969 26 p refs
(Grant AF-EOAR-35-66)
(AD-689283; AFOSR-69-1491TR) Avail: CFSTI CSCL 4/1

The research program has included studies of the composition and the energy spectrum of the primary cosmic radiation and studies of nucleus-nucleus interactions at medium and high energies. The investigations have been performed with nuclear emulsions which have been exposed to the primary radiation in high altitude balloon flights or in sounding rocket flights. The investigations of the primary radiation have mainly been concentrated on studies of the composition of the flux of heavy primaries. One of the main purposes of our research has been to investigate the composition of the radiation in different energy intervals. An investigation of the isotopic composition of the carbon in the primary flux was also performed. The studies of the nucleus-nucleus collisions have been concentrated on such interactions in which the primary particles either have had an energy larger than 2 GeV/nucleon or have had an energy in the interval 100 - 400 MeV/nucleon. Comparisons between nucleus-nucleus interactions have been performed in both energy intervals. Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N69-36004# European Space Operations Center, Darmstadt (West Germany).
THE DIFFERENTIAL CORRECTION OF CLOSE-EARTH SATELLITE ORBITS. PART 2: THE DIFFERENTIAL CORRECTION ORBIT PROGRAMME (DCOP)
H. G. Walter, I. M. Wales, and S. Pallaschke. Sep. 1968 57 p refs
(ESRO-SR-8(ESOC)) Avail: CFSTI

The Differential Correction of Close-Earth Satellite Orbits, ESRO SR-7 (ESDAC), deals with the theory and principles. Part II is intended as an operations manual for the Differential Correction Orbit Program (DCOP). In order that the manual may be used independently of Part I as far as possible, the report begins with a brief outline of the basic theory. Following this, details of input and output as well as computer configuration are given. The options which the program is capable of tackling and their explanations are mentioned in the appropriate place in the text. Included in the appendices are a flow chart of the program, a sample input deck and a sample printout. The computer program is written in FORTRAN language, level H. Author (ESRO)

N69-36050# Congress. Senate. Committee on Aeronautical and Space Sciences.
FUTURE NASA SPACE PROGRAMS
Washington GPO 1969 Hearings before Comm. on Aeron. and Space Sci., 91st Congr., 1st Sess., 5 Aug. 1969
Avail: Comm. on Aeron. and Space Sci.

Future NASA space programs were discussed. Emphasis was placed on the Apollo applications project; NASA's plan for a large manned space station and associated transport system; planetary exploration; and plans for astronomy, bioscience, and space applications. J.A.M.

N69-36127# Sao Paulo Univ. (Brazil). Center of Celestial Mechanics.
CELESTIAL MECHANICS: REGULARIZATION, PLANETARY THEORY, AND SATELLITE THEORY
Giorgio E. O.Giacaglia *In its* Res. in Celestial Mech. and Differential Equations May 1968 p 1–27 refs (see N69-36126 21-19)
Avail: CFSTI

Analysis of the generalized gravitational three-body problem is demonstrated in several studies. The process of regularization by the special transformations of variables when applied to a close-to-earth object permits the perturbative analysis of near parabolic orbits such as earth-to-earth trajectories. Then, a new model for the description of the periodic and secular variations of Pluto is delineated based on a numerical integration and approximation series. In this case, the Sun and Neptune are the primary bodies. Reduction of the data by canonical transformation provides predictive capability of the characteristics of motion for a long period of time. Secular characteristics of motion of asteroids in resonance with Jupiter are analyzed by nonlinear numerical integrative methods. New methods of solutions of lunar perigee motion and general perturbation theory applicable to satellite theory are also discussed. M.H.E.

N69-36143*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPROXIMATION TO THE STATISTICS OF MIDCOURSE VELOCITY CORRECTIONS
Lawrence H. Hoffman and George R. Young Washington Sep. 1969 40 p refs
(NASA-TN-D-5381) Avail: CFSTI CSCL 22A

A simple approximation for the mean and standard deviation of the magnitude of a statistical velocity correction vector is derived. Approximate methods are presented for making probability statements about the velocity correction vector. These methods are shown to be adequate for calculating the fuel budget for a velocity correction. Comparisons are made with exact results obtained by numerical integration. Results obtained by the root-sum-square method of determining a fuel budget are also compared with the exact numerically integrated results. The data presented indicate that the probability density function of the magnitude of a velocity correction vector can be fitted accurately with a gamma distribution having an integer shape parameter, and thus probability statements about the magnitude can be made. The accuracy of the gamma distribution fit is examined for a number of representative covariance matrices. Author

N69-36199*# New Mexico State Univ., Las Cruces. The Observatory.

MEASUREMENTS OF PLANETARY DIMENSIONS

E. J. Reese Jun. 1969 15 p refs

(Grants NGL-32-003-001; NGL-32-003-027)

(NASA-CR-105637; TN-701-69-30) Avail: CFSTI CSCL 03A

Recent measurements of planetary dimensions are summarized and the results based on measurements of good quality photographs with a Mann measuring machine are presented. The techniques used were essentially the same as these used by W. H. Wright (1925) and others. The photographic plates were exposed at the *f*:75 Cassegranian focus of the NMSU 61-cm reflector. The all-mirror optical system of this instrument provides a plate scale which is the same for light of all wavelengths. The plate scale was determined by photographing several pairs of stars in the Pleiades cluster whose separations are known with great accuracy. The photographic plates were developed in a low-contrast, fine-grain developer: UFG for Jupiter and HC 110 for the other planets. Author

N69-36206*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.

[SUMMARY OF THE PROGRAM OF RESEARCH, STUDY, AND ANALYSIS FOR THE LUNAR AND PLANETARY PROGRAMS DIVISION] Annual Summary Report, Jul. 1967 - Jun. 1968

Jul. 1968 73 p refs

(Contract NASr-65(06))

(NASA-CR-105561; A-5; ASR-5) Avail: CFSTI CSCL 22A

Summaries are presented of reports and technical memoranda published as a result of research on programs for lunar and planetary exploration. Topics of the published reports include an evaluation of the applicability of surface sampling to Mars exploration, guidelines on telemetry communications, and data on outer planet trajectories for the period 1975 to 2000. Technical memoranda published include an analysis of a Solar System Total Exploration Planning System (STEPS), an evaluation of the role of ground based observations in the exploration of Venus, and a study on the command link and atmospheric probe aspects of deep space communications. Included in these summaries are technical notes on which formal reports have not been written. In addition, four published technical papers covering advanced interplanetary missions are cited. D.L.G.

N69-36207*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GEOS-2 AND 13TH ORDER TERMS OF THE GEOPOTENTIAL

Bruce C. Douglas (Wolf Res. and Develop. Corp., Riverdale, Md.), James G. Marsh and Ronald G. Williamson (Wolf Res. and Develop. Corp., Riverdale, Md.) Jul. 1969 52 p refs Prepared by Wolf Res. and Develop. Corp., Riverdale Submitted for publication

(Contract NAS5-9756)

(NASA-TM-X-63637; X-552-69-291) Avail: CFSTI CSCL 22C

The odd-degree geopotential coefficients (13, 13), (15, 13), and (17, 13) most accurately model the resonance effects on GEOS-II of any of the published sets of 13th-order coefficients. However, this set is not adequate for precision orbit determination; additional even-degree coefficients are required. Values of $C_{14,13}$ ($= .57 \times 10^{-21}$) and $S_{14,13}$ ($= 6.5 \times 10^{-21}$) to be used with the odd-degree set were obtained from an analysis of the observed along-track position variation of GEOS-II. These coefficients, when used, yield greatly improved fits to the data and orbital prediction capability. The composite coefficients $C_{13,13}$ ($= 1.7 \times 10^{-20}$) and $S_{13,13}$ ($= +2.7 \times 10^{-20}$) were obtained under the assumption that the (13,13) spherical harmonic of the geopotential is responsible for all of the observed along-track variation of GEOS-II due to resonance. The good agreement of these deliberately composite values with some published values of $C_{13,13}$ and $S_{13,13}$ suggests that some of the published values may also be composite to a large extent. Tables of eccentricity and inclination functions for resonance with 12th through 15th order terms are presented. Author

N69-36223*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MIXING BETWEEN THE STELLAR CORE AND ENVELOPE IN ADVANCED PHASES OF EVOLUTION

Daiichiro Sugimoto Aug. 1969 15 p refs Submitted for publication

(NASA-TM-X-63642; X-641-69-349) Avail: CFSTI CSCL 03A

The evolution of stars of about 30 and 12 solar masses has been studied through the oxygen-burning phase. For the star of 30 solar masses it is found that an extensive surface convection zone invades deep into the stellar core, and the material in the core is mixed into the envelope. When the neutrino loss due the universal Fermi interaction is not taken into account, the results suggest that the core mass of a pre-supernova will be close to the Chandrasekhar limit. On the other hand, when neutrino loss is included, the mixing after the carbon-burning phase is found to be negligible, as the time scale of evolution is short compared with the time scale of heat transfer even near the bottom of the hydrogen-rich envelope. The evolution of a star of about 6 solar masses has been studied also. If there is neutrino loss, the mixing is found to be strong. Eventually, a pure helium envelope develops because of the co-existence of a deepening surface convection zone and hydrogen-shell burning. Author

N69-36254*# Techtran Corp., Glen Burnie, Md.

CONCERNING THE PROGRAM FOR PLANETARY ATMOSPHERIC RESEARCH

K. Ya. Kondratyev 1968 14 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 1, 1968 p 94 - 98 *Its* no. 22

(Contract NAS5-14826)

(NASA-CR-105621) Avail: CFSTI CSCL 22A

Discussions on three aspects of the program for planetary atmospheric research are summarized. In the area of numerical experiments for studying planetary atmospheric circulation, the validity of the initial meteorological information is critical in the application of the equations of thermohydrodynamics, and the assumption of boundary conditions. Issues of the adequacy of the atmospheric model and the computed errors were raised and improved weather prognostication was considered dependent on clearer distinctions between hydrostatic and nonhydrostatic atmospheric motion' and parameters being assigned to represent their effects. Summaries on the discussions regarding the future of satellite meteorology based on present technology denote the meteorological element, the method of determination, stage of development and of implementation, the resolving power and accuracy, and the area of application. Plans are reviewed for global systems of sounding balloons combined with ground and oceanic coordinated meteorological stations depending on special communication satellites requiring participation of scientists from various countries. M.H.E.

N69-36257*# American Nucleonics Corp., Glendale, Calif.

A THEORY FOR THE INTERPRETATION OF LUNAR SURFACE MAGNETOMETER DATA

Gerald Schubert (Calif. Univ., Los Angeles) and Kenneth Schwartz [1969] 30 p refs

(Contract NAS2-5153)

(NASA-CR-73363) Avail: CFSTI CSCL 03B

The solution to the problem of the electromagnetic interaction of the moon with spatial irregularities in the interplanetary magnetic field is found. The lunar electrical conductivity is modeled by a two-layer conductivity profile. For the interaction of the moon with the co-rotating sector structure ofthe interplanetary magnetic field it is found that the magnetic field in the lunar shell is the superposition of all oscillatory uniform field, an oscillatory dipole field and an oscillatory field that is toroidal about the axis of the motional electric field. With various lunar conductivity models and the theory of this paper, lunar surface magnetometer data can be quantitatively interpreted to yield information on the conductivity and consequently the temperature of the lunar core. Author

N69-36263*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INSTANTANEOUS ROTATIONAL VELOCITY OF MERCURY

Han-Shou Liu Jul. 1969 8 p refs Submitted for publication

(NASA-TM-X-63643; X-643-69-354) Avail: CFSTI CSCL 03A

The fluctuation in the angular velocity of the present rotation of Mercury is investigated. The instantaneous rotational rate in terms of orbital mean motion at different positions along Mercury's orbit is given. At aphelion the rotational velcoty decreases substantially because the solar gravitational torque on the two thermal bulges on Mercury's surface tends to retard the rotation of Mercury before aphelion passage. It is found that the difference between the rotational periods derived from the motions at perihelion and aphelion is 4.68 minutes. Author

N69-36264*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GRAVITATIONAL EXPERIMENTS FOR A PROPOSED VENUS ORBITER

Carl A. Wagner Aug. 1969 9 p refs

(NASA-TM-X-63640; X-552-69-340) Avail: CFSTI CSCL 03B

A Venus orbiter offers a unique opportunity to determine the oblateness and other anomalous gravitational properties of that cloud shrouded, moonless planet. While the Venus mass (or μ constant) should also be improved from the period and semi-major axis data on the orbiter, the most important new knowledge will come from tests of the anomalous properties of the gravitational field. These tests should be sensitive enough to detect low-order gravitational anomalies on Venus of about the same magnitude as those for the Earth. Reasonable lower bounds will be forthcoming from the long-term tracking of the Venus orbiter, on the nonequilibrium stress which the planet's interior is capable of supporting. Author

N69-36292*# Techtran Corp., Glen Burnie, Md.

SOME DATA ON PULVERIZED MATTER FROM THE REGION OF THE FALL OF THE TUNGUZ METEORITE

O. A. Kirova et al. 1968 17 p refs Transl. into ENGLISH from Meteoritika (Moscow), v. 27, 1966 p 119–127 refs *Its* No. 20

(Contract NAS5-14826)

(NASA-CR-105612) Avail: CFSTI CSCL 03B

Microchemical and mineralogical analyses of soil samples taken well beyond the boundaries of previous expeditions to the regions of the fall of the Tunguz meteorite are described in detail. The area of sampling was increased to 60,000 km^2. Processing of the pulverized matter from mother samples to the stage of trapped silicate and magnetite spheres is delineated. Preliminary conclusions on the morphological features are based on microchemical analysis of 1-2,000 spheres with an average diameter of 80 microns. Distributions of the magnetite spheres by diameters, microscopic inspection and counting of spheres and related formations, and colorimetric and spectral analysis of the magnetite and silicaceous samples indicate the heterogeneous composition of the initial material. These studies support the hypothesis that the meteorite core called Tunguz was cometary in nature. M.H.E.

N69-36312*# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.

STATISTICAL GEOMORPHOLOGY OF THE LUNAR SURFACE

L. B. Ronca and R. R. Green May 1969 40 p refs

(D1-82-0866) Avail: CFSTI

When the lunar crater areal density (number of craters per unit area) is contoured on the lunar surface, it is evident that lunar craters are not distributed at random. The terra-mare dichotomy is clearly indicated and also the terrae themselves display nesting and parallelism of the contours. A mathematical nesting index is defined, which varies from zero for a random set of contours to 1 for a perfect bull's eye. For the whole front face of the moon, the nesting index of all craters of class 1 (fresh craters) is 0.77, class 2 (craters with blurred rims) is 0.87, class 3 (craters with broken rims) is 0.90, class 4 (ruined craters) is 0.85, and class 5 (ghost craters) is 0.72. When only the southern terrae are considered, the nesting index is 0.83 for craters of all classes, 0.71 for craters of classes 1, 2, and 3 combined and 0.26 for craters of class 1. Author

N69-36368*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

OPTIMUM RENDEZVOUS GUIDANCE STUDY Final Report

Joerg Waldvogel Aug. 1969 60 p refs

(Contract NAS8-21146)

(NASA-CR-102234; LMSC/HREC-D149128; HREC-1146-2) Avail: CFSTI CSCL 22C

This study considers the problem of flight scheduling in the planar two-burn minimum fuel rendezvous of an interceptor with a target vehicle. A set of equations is developed which takes position and velocity of the interceptor and of the target as input data. These equations allow calculation of five control parameters: the durations of the first burn, of the coast, and of the second burn, and the average thrust direction for each burn period. In order to set up the rendezvous conditions, Levi–Civita's regularized variables and the corresponding orbital elements are used. Simulation results for a typical rendezvous case are included. Author

N69-36439*# International Business Machines Corp., Cambridge, Mass. Federal Systems Div.

RAPID OPTIMIZATION OF MULTIPLE-BURN ROCKET FLIGHTS, 8 MARCH 1968–8 MARCH 1969

K. R. Brown, E. F. Harrold, And G. W. Johnson Washington NASA Sep. 1969 55 p refs

(Contract NAS8-21315)

(NASA-CR-1430; IBM-150) Avail: CFSTI CSCL 22C

An indirect (shooting) method was developed for optimization of multiple-burn rocket flights. The method is fast enough to warrant consideration as a real-time guidance scheme, yet it is free of special-purpose approximations or artificial mission restrictions. The algorithm and the analysis on which it was based are described, and test results indicative of the power of the method are given. Author

N69-36451*# National Aeronautics and Space Administration, Washington, D.C.

SURVEYOR PROGRAM RESULTS Final Report

1969 432 p refs

(NASA-SP-184) Avail: SOD $4.75; CFSTI CSCL 03B

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1. SURVEYOR PROGRAM RESULTS: INTRODUCTION L. D. Jaffe and R. H. Steinbacher p 1 –12 refs (See N69-36452 21-31)

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3. TELEVISION OBSERVATIONS FROM SURVEYOR E. M. Shoemaker, E. C. Morris, R. M. Batson, H. E. Holt, K. B. Larson et al p 19–128 refs (See N69-36454 21-30)

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7. LUNAR SURFACE ELECTROMAGNETIC PROPERTIES D. O. Muhleman, W. E. Brown, Jr., L. Davis, J. Negus de Wys, and W. H. Peake p 203–269 refs (See N69-36458 21-30)

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9. LUNAR THEORY AND PROCESSES D. E. Gault, J. B. Adams, R. J. Collins, T. Gold, G. P. Kuiper et al p 351–367 refs (See N69-36460 21-30)

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13. EFFECTS OF LUNAR PARTICLES ON SPACECRAFT MIRROR SURFACES L. D. Jaffe and J. J. Rennilson p 407–412 refs (See N69-36464 21-31)

14. THE LUNAR SUNSET PHENOMENON L. H. Allen p 413–418 ref (See N69-36465 21-30)

N69-36453*# National Aeronautics and Space Administration, Washington, D.C.

PRINCIPAL SCIENTIFIC RESULTS FROM THE SURVEYOR PROGRAM

L. D. Jaffe, C. O. Alley, S. A. Batterson, E. M. Christensen, S. E. Dwornik et al *In its* Surveyor Program Restuls 1969 p 13–17 (See N69-36451 21-30)

Avail: SOD $4.75; CFSTI CSCL 03B

Lunar surface examinations at five Surveyor landing sites show that the lunar surface is covered by a layer of fragmentary debries which is littered with a variety of rocks and spotted craters. The cumulative size distribution of the craters indicates a prolonged, repetitive bombardment by meteoroids and by secondary fragments from the moon. Rock fragment surfaces exhibit evidence of an erosive, or abrasive, action and possess varying densities. Photometric measurements at landing sites show that the undisturbed fine matrix of the mare surface has a luminance factor of 7.3 to 8.2 percent. The presence of magnetic material is established and chemical analyses find as most abundent elements on the moon oxygen, silicon, and probably aluminum. G.G.

N69-36454*# National Aeronautics and Space Administration, Washington, D.C.

TELEVISION OBSERVATIONS FROM SURVEYOR

E. M. Shoemaker, E. C. Morris, R. M. Batson, H. E. Holt, K. B. Larson et al *In its* Surveyor Program Results 1969 p 19–128 refs (See N69-36451 21-30)

Avail: SOD $4.75; CFSTI CSCL 03B

Surveyor television pictures from the lunar surface were analyzed for the size distribution of craters and fragments; tickness of the fragemented debris layer ; and the colorimetric, photometric, and polarmetric properties of the various lunar surface materials. Included was a series of pictures on the earth's eclipse as observed from the Surveyor spacecraft. G.G.

N69-36455*# National Aeronautics and Space Administration, Washington, D.C.

LUNAR SURFACE MECHANICAL PROPERTIES

R. Choate, S. A. Batterson, E. M. Christensen, R. E. Hutton, L. D. Jaffe et al *In its* Surveyor Program Results 1969 p 129–169 refs (See N69-36451 21-30)

Avail: SOD $4.75; CFSTI CSCL 03B

Surveyor landing telemetry data are evaluated for their mechanical characteristics and the mechanical property sections of the Surveyer mission reports are summarized. Information presented includes data on soil corrosion, adhesion, permeability, compressibility, particle-size distribution, bearing strength, elasticity, frictional and light reflectance characteristics. G.G.

N69-36456*# National Aeronautics and Space Administration, Washington, D.C.

SOIL MECHANICS SURFACE SAMPLER

R. F. Scott and F. I. Roberson *In its* Surveyor Program Results 1969 p 171–179 refs (See N69-36451 21-30)

Avail: SOD $4.75; CFSTI CSCL 03B

Data acquired from soil mechanics surface-sampler experiments on Surveyor missions established the following lunar soil parameters: (1) the lunar surface is covered by fine grained soil over rocks, or rock fragments; its depth varies from 1 or 2 cm to 15 cm; (2) the cohesion behavior of the soil is consistent with a material possessing a cohesion of 0.35 to 0.7 $\times 10^4$ dynes/cm^2; (3) the soil resistance to penetration increases with depth in the top 1 or 2 cm; (4) the soil appears less dense at several millimeter depth; (5) the bearing capacity of the lunar soil to the 2.54 cm wide area of the surface sampler scoop is about 2.1 $\times 10^5$ dynes/cm^2; (6) the density of a single rock is in the range of 2.4 to 3.1 g/cm^3; (7) the surface part of an excavated rock was angular in contrast to the rounded visible part; and (8) the adhesion of lunar soil to the surface sampler scoop appears to increase with time on the lunar surface. G.G.

N69-36457*# National Aeronautics and Space Administration, Washington, D.C.

LUNAR SURFACE TEMPERATURES AND THERMAL CHARACTERISTICS

J. W. Lucas, W. A. Hagemeyer, J. M. Saari, L. D. Stimpson, and J. M. F. Vickers *In its* Surveyor Program Results 1969 p 181–202 refs (See N69-36451 21-30)

Avail: SOD $4.75; CFSTI CSCL 03B

Lunar surface temperatures, calculated from Surveyor spacecrafts thermal data, were compared with earth based measurements and theoretical thermophysical models. Errors associated with compartment based lunar surface temperature calculations were found significant particular during the lunar day; solar panel errors appear to be less and the equations simpler than those for the revised compartment model. Postsunset lunar surface temperatures derived from Surveyor V data and earth based measurements were in agreement with the error band. Directional emission of the lunar surface may have caused the temperature

differences between those derived from Surveyor compartment data and those predicted assuming Lambertian emission. The dust layer apparently had no appreciable effects on the thermal sensors. G.G.

N69-36458*# National Aeronautics and Space Administration, Washington, D.C.
LUNAR SURFACE ELECTROMAGNETIC PROPERTIES
D. O. Muhleman, W. E. Brown, Jr., L. Davis, J. Negus de Wys, and W. H. Peake *In its* Surveyor Program Results 1969 p 203–269 refs (See N69-36451 21-30)
Avail: SOD $4.75; CFSTI CSCL 03B

Analysis and interpretation of the Surveyor data on electromagnetic properties of the lunar surface material developed the following conclusions: (1) a small amount of magnetic material is present at all Surveyor landing sites; (2) all lunar results are consistent with laboratory studies using finely powdered basalts; (3) surface sampler magnets attract magnetite or meteoritetic nickel-iron. It is suggested that the lunar surface material is of volanic origin. G.G.

N69-36459*# National Aeronautics and Space Administration, Washington, D.C.
THE ALPHA-SCATTERING CHEMICAL ANALYSIS EXPERIMENT ON THE SURVEYOR LUNAR MISSIONS
A. L. Turkevich, W. A. Anderson, T. E. Economov, E. J. Franzgrote, H. E. Griffin et al *In its* Surveyor Program Results 1969 p 271–350 refs (See N69-36451 21-30)
Avail: SOD $4.75 CFSTI CSCL 03B

Computer analyses of alpha scattering spectra from lunar site samples, obtained during Surveyor 5, 6, and 7 missions,indicate that the most abundant element on the moon is oxygen followed by silicon and aluminum. The upper limits of carbon and sodium in the samples constitute 2 to 3 atomic percent. Thus, all values indicate a gross similarity in chemical composition to that of rocks found on earth. G.G.

N69-36460*# National Aeronautics and Space Administration, Washington, D.C.
LUNAR THEORY AND PROCESSES
D. E. Gault, J. B. Adams, R. J. Collins, T. Gold, G. P. Kuiper et al *In its* Surveyor Program Results 1969 p 351–367 refs (See N69-36451 21-30)
Avail: SOD $4.75; CFSTI CSCL 03B

Results of the chemical analysis on lunar samples by the alpha scattering method are compared with terrestrial and meteoritic analogs. Identified elements are shown in tables and the similarity of atomic abundances to those of basaltic rocks is used to infer a mineralogy. The densities of these minerals and their solid solutions are determined almost entirely by the proportion of iron; iron content variations from the mare sites to the highland site account for a change in opacity and affect the albedo of the whole rock powder. The chemical analyses provide strong evidence that melting has occurred in the moon. G.G.

N69-36461*# National Aeronautics and Space Administration, Washington, D.C.
SURVEYOR POSTTOUCHDOWN ANALYSES OF TRACKING DATA
F. B. Winn *In its* Surveyor Program Results 1969 p 369–395 refs (See N69-36451 21-30)
Avail: SOD $4.75; CFSTI CSCL 03B

Three lunar ephemerides were used in the processing of Surveyor post touchdown Doppler tracking data and LE 5 evolved as the most accurate lunar ephemeris of long term periodicity of one lunation and amplitude of 0.7 mm/sec. The selenocentric distance, latitude, and longitude for Surveyors 5 and 6 were determined and are shown in table form. A high selenocentric distance-selenocentric latitude and longitude correlation provided a solution for the lunar surface coordinates of Surveyors 7 and 3, respectively; however, the Surveyor 1 position determination was distorted by a high correlation between selenocentric longitude and distance. The new integrated ephemeris LE 6, demonstrated a time-dependent ability to diminish the diurnal signature of Surveyor 7 residuals. A combination refractivity parameter was used for optimal data first on Surveyors 5 and 7. G.G.

N69-36463*# National Aeronautics and Space Administration, Washington, D.C.
ASTRONOMY: SOLAR CORONA OBSERVATIONS
R. H. Norton *In its* Surveyor Program Results 1969 p 405 refs (See N69-36451 21-30)
Avail: SOD $4.75; CFSTI CSCL 03A

Solar corona observations by Surveyor television cameras during post sunset periods are presented. After the upper limb of the solar disk had set behind the western horizon, a sequence of timed pictures was taken with gradually increasing exposures. Because photometric reduction of all pictures has not been completed, no final conclusions were made at this time. Author

N69-36465*# National Aeronautics and Space Administration, Washington, D.C.
THE LUNAR SUNSET PHENOMENON
L. H. Allen *In its* Surveyor Program Restuls 1969 p 413–418 ref (See N69-36451 21-30)
Avail: SOD $4.75; CFSTI CSCL 03B

Optical evaluation of the bright, jagged, discontinuous line in Surveyor television pictures of the lunar sunset horizon established vidicon leakage white spread function and a clamping action when the white direction threshold level was exceeded, as the contributing factors of this phenomenon. The resulting overshoot, with the introduction of blacker than black signals, gave the illusion that the lunar bright line was suspended above the surface. The diffraction of sunlight by the horizon or edge of the lunar surface material diminished as the Sun completely set and the penumbra angle vanished. G.G.

N69-36472*# Martin Co., Denver, Colo.
SIMULATED TRAJECTORIES ERROR ANALYSIS PROGRAM. VOLUME 1: USER'S MANUAL Final Report
Gentry Lee, Ralph Falce, Doyle Vogt, Shearon Pearson, and Eva Demlow Aug. 1969 545 p refs
(Contract NAS1-8745)
(NASA-CR-66818) Avail: CFSTI CSCL 22C

The formulation, computational logic, input/output options, subroutine description, and other pertinent information that should aid the user of the simulated trajectories error analysis program were presented. The program has four modes of operation: trajectory, targeting, error analysis, and simulation. The trajector and targeting modes are based on an n-body subroutine that uses the virtual mass or varicentric technique. The fundamental technique used in developing the error analysis and simulation modes is the Kalman recursive filter algorithm. Author

N69-36473*# Martin Co., Denver, Colo.
SIMULATED TRAJECTORIES ERROR ANALYSIS PROGRAM. VOLUME 2: ANALYTICAL MANUAL Final Report

Gentry Lee, Ralph Falce, Doyle Vogt, Shearon Pearson, and Eva Demlow Aug. 1969 41 p refs
(Contract NAS1-8745)
(NASA-CR-66819) Avail: CFSTI CSCL 22C

The mathematical techniques used in the program are explained and typical results are given, with explanations, that demonstrate the efficacy of the program. A general description of the simulated trajectories error analysis program and the operational modes of the program are presented. The symbols used through the text and the analytical techniques used for the development of each operational mode of the program are presented in detail. A discussion of many test runs made with the program is intended to demonstrate the multifarious uses for the program. Author

N69-36475*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
LUNAR ORBITER SELENODESY STUDIES Quarterly Reports, 1 Jan. – 30 Jun. 1969
William M. Kaula 30 Jun. 1969 5 p
(Contract NSR-05-007-083; Grant NGL-05-007-002)
(NASA-CR-105648; QR-11; QR-12) Avail: CFSTI CSCL 22A

Analyses of selenodesy studies from a lunar orbiter are presented. Tracking data and an error analysis of the laser ranging of the moon are also included. Emphasis is placed on the interpretation of lunar mass concentration. The topic of mass concentration is divided into three parts; the creation of the mass excess, the support of the mass excess, and the probability of a mechanism other than those associated with mass transfer which would make the ringed maria denser. Author

N69-36662# Joint Publications Research Service, Washington, D.C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 207
1 Jul. 1969 73 p Transl. into ENGLISH from Russian articles (JPRS-48326) Avail: CFSTI

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1. ASTRONOMY p 1 – refs (See N69-36663 21-30)
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3. OCEANOGRAPHY p 15 – 18 refs (See N69-36665 21-13)
4. TERRESTRIAL GEOPHYSICS p 19 – 28 refs (See N69-36666 21-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 29 – 47 refs (See N69-36667 21-30)
6. AN IMPORTANT STEP IN UNDERSTANDING THE UNIVERSE p 49 – 66 (See N69-36668 21-30)

N69-36663# Joint Publications Research Service, Washington, D.C.
ASTRONOMY
In its Soviet-Bloc Res. in Geophys., Astron., and Space, No. 207 1969 p 1 2 refs (See N69-36662 21-30)
Avail: CFSTI

Analyzed is the construction of radio interferometers with phased independent heterodynes at each reception point for accurate matching of the recorded signals. It is shown that appropriate information processing in a five element interferometer derives the required equations for the phases of the spectral components of the source spatial distribution of radio brightness. Also considered is the formation of dense matter star systems by the hypothesis that the form preceding a galaxy is a superstar and by developing the corresponding stellar models. Emphasis is placed on the characteristics of a system generated by a rotating superstar with the exchange of matter between the star and the interstellar medium. G.G.

N69-36667# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet-Bloc Res. in Geophys., Astron., and Space, No. 207 1 Jul. 1969 p 29 – 47 refs (See N69-36662 21-20)
Avail: CFSTI

Described are development and flights of the Soviet space stations Venera 5 and Venera 6. Both stations successfully completed their flights by smoothly descending into the Venerian atmosphere after undergoing extensive pre-flight testing. Outlined are plans for a space station flight to Pluto that will be accelerated on his way by the gravitational fields of Jupiter, Saturn, and Uranus. The basic facts of the Apollo 10 flight are presented and the continuation of manned space flight into space is advocated. Included scientific abstracts depict flight control optimization studies and analyses on ionized interstellar gas and ionospheric layers. G.G.

N69-36668# Joint Publications Research Service, Washington, D.C.
AN IMPORTANT STEP IN UNDERSTANDING THE UNIVERSE Supplement
In its Soviet-Bloc Res. in Geophys., Astron., and Space, no. 207 1 Jul. 1969 p 49 – 66 Transl. into ENGLISH from TASS Report (Moscow), 4 Jun. 1969 (See N69-36662 21-30)
Avail: CFSTI

The successful flights of the Soviet space stations Venera 5 and Venera 6 are announced and the main stages in the projected study of Venus are outlined. During their flights, the space stations measured solar and galactic cosmic rays, the composition of the interplanetary plasma, and the diffuse ultraviolet solar radiation. Measurements fluctated according to the sun's cyclic activity. Data on plasma streams in the vicinity of Venus show that interplanetary space is full of plasma streams moving away from the sun at velocities equivalent to several hundred kilometers per second. Descent capsule analyses on Venus atmosphere composotion establish a carbon dioxide concentration of 93 to 97 percent, a nitorgen and inert gas abundance of two to five percent, while oxygen makes up no more than 4 percent. Other measurements transmitted by the probes show that Venus has a thick dense atmosphere with very high pressure and temperature values at its surface. G.G.

N69-36687*# Jet Propulsion Lab., Calif. Inst.of Tech., Pasadena.
RESEARCH AND ADVANCED DEVELOPMENT. VOLUME 1: SUPPORTING RESEARCH AN TECHNOLOGY FOR THE OFFICE OF SPACE SCIENCES AND APPLICATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Semiannual Reivew, 1 Jan. – 30 Jun. 1968
15 Oct. 1968 388 p refs
(Contract NAS7-100)
(NASA-CR-105605; JPL-701-18-Vol-1) Copyright. Avail: CFSTI CSCL 22A

A review of all supporting research and technology in progress at the Jet Propulsion Laboratory is presented for the period January 1 to June 30, 1968, under the direction of the JPL Office of Research and Advanced Development, for the NASA Office of Space Sciences and Applications. The work units are arranged in numerical sequency by NASA code in each subject section. JPL research and advanced development results published during this report period are listed under each work unit. Author

N69-36740*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLUTION OF LAMBERT'S PROBLEM FOR SHORT ARCS
E. R. Lancaster Aug. 1969 10 p refs
(NASA-TM-X-63656; X-643-69-370) Avail: CFSTI CSCL 22C

A boundary value problem is solved by differentiating column matrices with respect to scalars. The method developed, while limited to cases of moderate time-span, offers a concise explicit formula with no need for iteration, and has the advantage of allowing for completely general velocity-independent force functions. The method was found useful in calculation of short arc intercept trajectories, in preliminary orbit determination from observation of the position of the spacecraft at two times, and for ephemeris interpolation. Author

N69-36745*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIATION SCALES AND THE SOLAR CONSTANT
Charles H. Duncan Sep. 1969 14 p refs Submitted for publication
(NASA-TM-X-63659; X-713-69-382) Avail: CFSTI CSCL 03B

The radiation scales in use for radiometry are studied, and their derivations are presented with the conversion factors. The scales considered are: Thermodynamic Kelvin Scale, Internation Practical Temperature Scale, Smithsonial Scale with revisions, and the Angstrom Scale. A review of recent measurements of the solar constants is included. It is concluded that the solar constant as determined with total radiation detectors is too high, and that a reasonable value to assume for the solar constant is 135.2 mw cm $^{-2}$. F.O.S.

N69-36777# National Aeronautics and Space Council, Washington, D.C.
KEYNOTE ADDRESS: SPACE PERSPECTIVE
Edward C. Welsh *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 1-7 (See N69-36776 21-04)
Avail: CFSTI

The role of technology, with particular emphasis on the effects of the space program on the U.S. economy, is briefly mentioned together with anticipated future space activities and their possible contribution to the nation's overall welfare and progress. It is emphasized that the benefits of space technology, as derived from the vast research effort behind the program, must be defined and passed on both at a nationwide and international level. A.C.R.

N69-36778# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ON FUNDAMENTAL SCIENTIFIC ADVANCES RESULTING FROM THE SPACE PROGRAM
Fred L. Whipple *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 9-23 refs (See N69-36776 21-04)
Avail: CFSTI

The scientific advances that have resulted from the space program and its contribution to national needs and goals are treated. Specific aerospace research projects are discussed briefly, including the study of magnetic fields and high energy particles in space; X-ray and ultraviolet astronomy; the use of orbiting satellites in meteorology, as aids in more objective weather forecasting; and satellite geodesy. The benefits already accrued from such research and possible application of aerospace technology to new areas of human progress are then mentioned. A.C.R.

N69-36781# Palomar Observatory, Pasadena, Calif.
PHYSICS OF THE UNIVERSE
F. Zwicky *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 63-81 refs (See N69-36776 21-04)
Avail: CFSTI

A morphological approach to the physics of the universe is presented. Specifically, this involves study of the interrelations among objects, phenomena, concepts, ideas, and human actions. The objects of the universe are categorized as: (1) a hierarchy of distinct objects, starting with elementary particles, atoms, molecules, liquids and crystals, and moving to cosmic bodies and living organisms; and (2) stars, galaxies, and clusters of galaxies. The physical phenomena are discussed as related to the geography of cosmic space and the multiplicity of physical phenomena. Evidence for the uniformity of objects and phenomena throughout the universe is also presented. Finally, future directions indicated in the search for understanding of the physical phenomena underlying its universe are postulated. A.C.R.

N69-36790# Massachusetts Univ., Amherst. Hasbrouck Lab.
CONDITIONS ON THE PLANET VENUS
John D. Strong *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 249-254 refs (See N69-36776 21-04)
Avail: CFSTI

A brief summary of the present state of knowledge concerning the planet Venus is presented, and possible future work is suggested. Emphasis is given to investigations of the Venutian atmosphere by astronomers and satellite observations. Data have also been gathered concerning the surface temperature. Future areas of experiment include measurement of the entire infrared emission spectrum with a balloon telescope, atmospheric studies by rocket-ultraviolet observations, and a drop-sonde landed near the planet's pole. A.C.R.

N69-36791# Sacramento Peak Observatory, Sunspot, N.Mex.
THE SUN
John W. Evans *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 255-269 refs (See N69-36776 21-04)
Avail: CFSTI

Recent information concerning solar activity is described. Most solar activity occurs in limited areas called active centers, the basic ingredient of which is a powerful magnetic field with peak field strengths of 1000 to 4000 gauss. All observable phenomena, sunspots and flares in particular, are manifestations of the magnetic field and its changes. Flares typically occur in the more spectacular sunspot groups where complex structures mirror complex magnetic fields. Unlike the large sunspots, which develop and decay over longer periods of time, the flares are rapidly changing features that rarely last as long as three hours. This phenomena is particularly observable in photographs in the light of the H_{α} line of hydrogen, and hypotheses are made for the associated ejection of electrons and protons into space. The hazards of such radiation to space vehicles are also identified. Finally, the 11-year cycle of solar activity is treated, along with analysis related to the reliability of currently used techniques for forecasting significant solar events. A.C.R.

N69-36792# School of Aerospace Medicine, Brooks AFB, Tex.
EMPIRICAL ARGUMENTS CONCERNING DIRAC'S GRAVITATIONAL HYPOTHESIS
Pascual Jordan *In its* Bioastronaut. and the Exploration of Space Nov. 1968 p 271-289 refs (See N69-36776 21-04)
Avail: CFSTI

Dirac's hypothesis based on cosmology and the theory of elementary particles that the gravitational constant, G, may be a variable, diminishing extremely slowly in the course of the development of the universe, is analyzed; and possible arguments against the theory put forth by other authors are discussed. Possibilities of testing the hypothesis by direct precision measurements, the surest method of proof, are treated. It is emphasized, however, that improvement in measurement of planetary distances by the radar echo method is still not sufficient for this purpose, although laser echo measurements from reflectors placed on the moon should be more precise. Another factor, that of nonlinear deviation of ephemeris time from inertial time, is presently under investigation. Attempts to satisfactorily prove the hypothesis based on lunar evidence have not yet been successful, due to the question of whether the lunar craters are volcanic in nature or the result of meteorite impacts. It is concluded, however, that the great bulk of empirical knowledge about the history of the earth is favorable to Dirac's theory. A.C.R.

N69-36793# Autonetics, Anaheim, Calif. Astrionics Div.
A STRATEGIC APPROACH TO INTERPLANETARY FLIGHT
Krafft A. Ehricke *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 287–386 refs (See N69-36776 21-04)
Avail: CFSTI

This approach incorporates science, technology, and exploration as important components of the total effort, but aims at a more fundamental objective defined as the stepwise acquisition of the solar system through exploration, occupation, and utilization/exploitation. The core of the concept is recognition of future human needs for resources beyond this planet, primarily in the region extending from Mercury to Jupiter. It is recommended that strategic planning for orbital and lunar missions should be mission-oriented, but solar exploration should be capability-oriented toward a broad, multi-mission program involving many planets and seeking their potential usefulness based on long range considerations. In manned missions, heliocentric transfer times must be reduced to a minimum, because the utilization exploitation potential of a new region is only as good as the means of transportation available. Finally, propulsion is also of central importance, since a system with high specific impulse and relatively high thrust acceleration is required for optimum transfer capability. The principal candidates are nuclear pulse systems, controlled thermonuclear reactors, nuclear-electric drive, and the gaseous core reactor. A.C.R.

N69-36800# School of Aerospace Medicine, Brooks AFB, Tex.
NEXT: THE PLANETS
Arthur C. Clarke *In its* Bioastronaut. and the Exploration of Space Nov. 1968 p 511–525 refs (See N69-36772 21-04)
Avail: CFSTI

A brief parallel is drawn between the history of aeronautics and astronautics to the present time, and the nature of future planetary exploration is postulated. Factors considered include the advisability of near space, rather than deep space exploration, in the coming years, manned versus unmanned missions, and earth-based research systems such as advanced astronomical complexes as opposed to actual space probes. The present lack of knowledge concerning the planets in the solar system is emphasized; this includes their fundamental physical structure, atmospheric conditions, and likelihood of life. A.C.R.

N69-36801# Air Force Missile Development Center, Holloman AFB, N.Mex.
IMPORTANCE OF THE USE OF EXTRATERRESTRIAL RESOURCES TO THE ECONOMY OF SPACE FLIGHT BEYOND NEAR-EARTH ORBIT
Ernst A. Steinhoff In School of Aerospace Md. Bioastronaut. and the Exploration of Space Nov. 1968 p 527–551 (See N69-36776 21-04)
Avail: CFSTI

Extraterrestrial resources, considered as resources which can maintain flight and humal life without earth-derived logistics, are discussed, and it is concluded that such sources are required for self-contained exploration, operation, and settlement, as well as transportation, in regions beyond the earth's influence. Physical phenomena are also included in this difinition if they permit conduction of processes or operations which would be difficult or less economical to achieve on earth. These resources could be minerals used to produce fuel, breathing oxygen, building materials for encampments, or materials to replenish life support systems. Proposals for using the extraterrestrial environment such as that on the moon, for providing commercial products difficult to produce on earth are based on assumption of the cost reduction possibilities of the production environment of low or vacuum conditions, different temperature and radiation levels, and cheaper cost of transportation for very heavy or voluminous materials. A.C.R.

N69-36803*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXTRATERRESTRIAL BIOLOGY: PROSPECTS AND PROBLEMS
Harold P. Klein *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 569–593 refs (See N69-36776 21-04)
Avail: CFSTI CSCL 03A

Theories concerning the evolution of life in the universe, supported from information gleaned over the years from astronomical observations, as well as various space flight projects, are discussed. Difficulties of acquiring the indisputable proof of such assumptions are also treated including the great distances that must be traveled to reach various stellar systems and the costs and hazards which go along with such an undertaking. Feasible targets in the search for the evolution of life, such as the moon and other planets in this solar system, are identified, and simulation studies for this purpose and problems in planning various life detection experiments are treated. Finally, the recommendation is made that scientific motivations for greater understanding of the space around the earth are of sufficient importance to the future of this planet to warrant the continued search for extraterrestrial life, despite the fact that it appears unlikely to exist in any developed form within this solar system. A.C.R.

N69-36837# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
PLANETARY PHYSICS: OPTICAL PROPERTIES AND THICKNESS OF THE RINGS OF SATURN OBSERVED EDGEWISE IN 1966
Audouin Dollfus et al Aug. 1969 11 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. Paris (Paris), Ser. B, v. 268, 6 Jan. 1969 p 100–103
(TR-54) Avail: CFSTI

Seventy-two plates obtained in 1966 at the time of the passage of the earth and the sun in the plane of Saturn's rings gave the luminance (i.e., brightness) of the B ring as a function of the elevation of the sun above its plane. The luminance of the B ring lighted by transparency may be 1/50 of the direct light. The illumination of the ring by the globe of Saturn may be 1.4×10^{-3} times the brightness of the center of the disk. The thickness of the rings, 2.8 ± 1.5 km. Author

N69-36883# Tokyo Astronomical Observatory (Japan).
A STUDY OF INTERSTELLAR MATTER IN THE CASSIOPEIA-PERSEUS REGION. PART 1: A CATALOGUE OF

EQUAL-VELOCITY CONTOUR DIAGRAMS OF NEUTRAL HYDROGEN 21-cm RADIATION FOR THE REGION FROM 127 DEG TO 140 DEG (III), FROM MINUS 1 DEG TO PLUS 1 DEG (bII) DERIVED FROM MARYLAND-GREEN BANK GALACTIC 21-cm LINE SURVEY, FIRST EDITION

Fumio Sato 1969 60 p refs /ts Annals, Ser. 2, Vol. 11, No. 2

Avail: CFSTI

Twenty-six equal velocity contour diagrams derived from the first edition of the Maryland - Green Bank galactic 21-cm line survey are presented for the region along the galactic equator. Radial velocities from 0 to −60 km/sec are covered at intervals of 2 or 3 km/sec. Author

N69-36892*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OPTICAL SIMULATION OF A RADIO-ASTRONOMY INTERFEROMETER EXPERIMENT

James P. Strong, III Washington Sep. 1969 15 p

(NASA-TN-D-5357) Avail: CFSTI CSCL 03B

A laser technique has been used to simualte processed output from a proposed spaceborne radio-astronomy interferometer experiment comprising two satellites separated by a controlled distance. The experiment effectively transmits the Fourier transform of the radio stars over the celestial sphere. The Fourier transform is a function of the distance between the two satellites and of the direction of the line connecting them. The existence of upper and lower bounds on the distance between the satellites creates voids in the Fourier transform space, causing resolution problems in the reconstruction of the star pattern on the ground from the Fourier transform. Because coherent optical techniques can obtain the two-dimensional Fourier transform, they can be used to simulate the proposed experiment. Optical filters can be made which represent the voids in the Fourier transform of the star pattern. An inverse transform shows the effects of the filtering, simulating the effects of the voids. Optical filtering in general and the particular optical system used are discussed. Results are shown for 1-MHz and 10-MHz RF sources, representing the worst and the best resolution expected. Author

N69-36900*# Geological Survey, Washington, D.C.

EXPERIMENTAL STUDIES ON THE FORMATION OF LUNAR SURFACE FEATURES BY GAS EMISSION: A PRELIMINARY REPORT

S. A. Schumm Jun. 1969 24 p refs /ts Interagency Rept., Astrogeology 18

(NASA ORDER R-66)

(NASA-CR-105749) Avail: CFSTI CSCL 03B

Descriptions are given of a series of experiments for demonstrating that lunar sinuous rilles could have formed as a result of fluidization of loose surficial materials by gases vented from lunar crustal fractures. A flume 2.4 meters long, 30 cm wide, and 27 cm deep was constructed, and a trough 5 cm wide and 2.5 cm deep was built into the floor of the flume. The flow of compressed air entering the gas chamber was regulated by a valve, and a pressure gage and flow meter were connected to the pipe trough. Leaks, although preventing collection of meaningful data on flow rates, did not interfere with development of the experimental features. Author

N69-36930*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A UNIFIED FORM OF LAMBERT'S THEOREM

E. R.Lancaster and R. C. Blanchard Washington Sep. 1969 15 p refs

(NASA-TN-D-5368) Avail: CFSTI CSCL 12A

A unified form of Lambert's theorem is presented which is valid for elliptic, hyperbolic, and parabolic orbits. The key idea involves the selection of an independent variable x and a parameter q such that the normalized time of flight T is a single-valued function of x for each value of q. The parameter q depends only upon known quantities. For less than one revolution, T is a monotonic function of x for each q, making possible the construction of a simple algorithm for finding x, given T and Q. Detailed sketches are given for T(x, q) and formulas developed for the velocity vectors at the initial and final times. Also included is a careful derivation of the classical form of Lambert's equations, including the multirevolution cases. Author

N69-36982*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LUNAR MASCON EVIDENCE FROM APOLLO ORBITS

James P. Murphy and Joseph W. Siry Jul. 1969 17 p refs

(NASA-TM-X-63652; X-550-69-312) Avail: CFSTI CSCL 22A

Apollo 8 tracking data were analyzed to obtain new evidence for a lunar mass concentration (mascon) in the neighborhood of Sinus Aestuum. Data for elliptical and nearly circular lunar orbits of Apollo 8 can be interpreted in terms of a mascon in this region at a depth of approximately 100 kilometers which has a mass on the order of 5×10^{-8} lunar masses and gives rise to a gravitational anomaly at the lunar surface of roughly 250 milligals. Author

N69-37037# Library of Congress, Washington, D.C. Science and Technology Div.

UFO'S AND RELATED SUBJECTS: AN ANNOTATED BIBLIOGRAPHY

Lynn E. Catoe Jul. 1969 415 p refs Prepared in cooperation with Colorado Univ.

(Contract F44620-67-C-0035)

(AD-688332; AFOSR-69-1656) Avail: SOD $3.50; CFSTI CSCL 1/2

The report is an annotated bibliography of books, journal articles, pamphlets, conference proceedings, tapes, original manuscripts, books of photographs, cartoons, motion picture films and other such material on the subject of unidentified flying objects (UFOs), totaling more than 1,600 separate items, with author index. Major categories include: UFOs, origin of life, mankind, solar system, extraterrestrial life, e.t. visitors, ball lightning and fireballs, disc-like aircraft, unidentified submarine objects, Fortean phenomena, UFOs and religion, UFOs and time, gravity and anti-gravity, hollow earth theory, disappearances, cartoons, mirages, and related subjects. Author (TAB)

N69-37058# Rice Univ., Houston, Tex. Dept. of Physics.

PRINCIPLES OF STELLAR EVOLUTION AND NUCLEOSYNTHESIS

Donald D. Clayton Jan. 1969 625 p refs

(Grant AF-AFOSR-955-65)

(AD-688906; AFOSR-69-1534TR) Avail: Mc Graw-Hill Book Co., New York, $22.50; CFSTI CSCL 3/2

The fields of stellar evolution and nucleosynthesis comprise one of the most vital and intriguing areas of modern scientific research. The recent build-up in the space exploration program has been accompanied by a new surge of interest in the physics of natural phenomena. Since stars are the most common element in the universe, much of our knowledge is moderated by our concepts of their structure and evolution, and the synthesis of elements from which they are formed. This is the first text to present the basic physical principles of stellar evolution and nucleosynthesis. The book provides a clear statement of the ideas which dominate

modern research in the hope that it will attract more students into this exciting field. By concentrating on the physical principles, the author has attempted to clarify the theoretical ideas which will prove valuable in a wide variety of future problems. Author (TAB)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N69-36009# Congress. House. Committee on Science and Astronautics.
AUTHORIZING APPROPRIATIONS TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
George P. Miller Washington GPO 1969 178 p Presented by the Comm. on Sci. and Astronaut. at th 91st Congr., 1st Sess., 19 May 1969
(Rept-91-255) Avail: US Capitol, House Document Room

A Congressional committee report dealing with the NASA appropriations bill advises specific authorization of funds for research and development, construction of facilities, and research and program management. Included are the Apollo, space flight operations, advanced missions, physics and astronomy, lunar and planetary exploration, bioscience, space application, launch vehicle procurement, and university programs. Space vehicle, electronic, human factor, and space power and electric propulsion systems are also considered, along with work associated with chemical propulsion, aeronautical vehicles, tracking and data acquisition, and technology utilization. Descriptions and budget breakdowns are provided for each NASA program and office. L.B.H.

N69-36010*# National Aeronautics and Space Administration, Washington, D.C.
PIONEER E: PRESS KIT
22 Aug. 1969 37 p
(NASA-News-Release-69-116) Avail: NASA Scientific and Technical Information Division

Details on the launch of Pioneer E, last in the interplanetary Pioneer spacecraft series, are presented. Background material is provided for an understanding of solar space, as well as the scientific instruments, investigations, and experiments related to Pioneer E. The spacecraft itself and the Delta launch vehicle are described, accompanied by an analysis of nominal Delta flight events for the mission. Consideration is also given to the Test and Training Satellite (TETR-C) and the Deep Space Network's tracking provisions. Pioneer project officials are listed and illustrations are included. L.B.H.

N69-36016*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER 4 HANDBOOK
1 Nov. 1968 235 p
(Contract NAS7-100)
(NASA-CR-105434; JPL-TM-33-406) Copyright. Avail: CFSTI CSCL 22A

A compilation of significant technical data relative to Mariner 4 is presented with the purpose of collecting in one location a wide variety of statistical information. The information presented pertains primarily to the Mariner spacecraft, and not to other areas of the total Mariner 4 project. The data are divided into three phases of the mission. Author

N69-36189*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPTIMUM STRUCTURAL DESIGN BASED ON RELIABILITY AND PROOF-LOAD TEST
Masanobu Shinozuka and Jann-Nan Yang [1969] 17 p refs
(Contract NAS7-100)
(NASA-CR-105624) Avail: CFSTI CSCL 22B

An approach in structural optimization based on reliability analysis is presented with an emphasis on the use of the proof-load test. Described in detail are methods of optimizing the structural weight subject to a constraint on the expected cost, which is an extended version of the constraint on the probability of failure. Depending on whether the structure is statically determinate or indeterminate, different methods of optimization are described. Numerical examples indicate that the expense of performing the proof-load test is always well compensated by the improvement of structural reliability due to such a test. In fact, under the constraint of the same expected cost, significant weight savings can be expected of a structure with proof-load-tested components, compared with the optimum weight of the structure consisting of components that are not proof-load-tested. Author

N69-36210*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.
DYNAMICS AND CONTROL OF FLEXIBLE SPACE VEHICLES
P. W. Likins 15 Feb. 1969 90 p refs
(Contract NAS7-100)
(NASA-CR-105592; JPL-TR-32-1329) Avail: CFSTI CSCL 22B

The purpose of this report is to survey the established analytic procedures for the simulation of controlled flexible space vehicles, and to develop in detail methods that employ a combination of discrete and distributed ("modal") coordinates, i.e., the hybrid-coordinate methods. Analytic procedures are described as discrete-coordinate methods, hybrid-coordinate methods, and vehicle normal-coordinate methods. Each of these approaches is described and analyzed for its advantages and disadvantages, and each is found to have an area of applicability. The hybrid-coordinate method combines the efficiency of the vehicle normal-coordinate method with the versatility of the discrete-coordinate method, and appears to have the widest range of practical application. The results of this study have practical utility in two areas: (1) complex digital computer simulation of flexible space vehicles of arbitrary configuration subject to realistic control laws; and (2) preliminary control system design based on transfer functions for linearized models of dynamics and control laws. Author

N69-36281*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMMUNICATIONS SATELLITE TECHNOLOGY IN THE NEXT DECADE
R. A. Stampfl comp. Apr. 1968 32 p ref
(NASA-TM-X-63627; X-701-68-137) Avail: CFSTI CSCL 22B

After initial experimentation at lower altitudes, the American commercial communications satellites program has settled on, and is likely to continue exclusive use of, geosynchronous orbits perhaps making use of orbital inclination to the equatorial plane to obtain specific geographical coverage. System capability during the next decade will exceed current economic and rate regulatory considerations. Hence, reliability and long life will be emphasized to lower communication costs even more than commercial communications satellites have achieved. It is anticipated that system capability will be extended to relay TV channels on a routine basis

and provide broadcasting to community receivers for educational purposes. Further, the system capability will provide higher gain, multiple access, and special-purpose links heretofore not served operationally by satellites. One special-purpose link would be intercontinental communication and air-traffic control combined with data collection. Author

N69-36315*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
THE ROLE OF S. P. KOROLEV IN THE DEVELOPMENT OF SOVIET ROCKET TECHNOLOGY DURING THE PERIOD OF ITS ORIGIN AND ESTABLISHMENT (1930–1941)
Yu. V. Biryukov *Its in* Trans. of the Tenth Sci. Conf. of the Inst. of Hist. of Nat. Sci. and Tech. Sep. 1969 p 1–12 refs (See N69-36314 21-34)
Avail: CFSTI CSCL 22B

The paper discusses the multiple roles of S.P. Korolev in the development of Soviet rocket technology during the period of its origin and establishment. Inspired by the teachings of Tsiolkovskiy and Tsander, Korolev went on to become instrumental in the organization of the Group for the Study of Jet Propulsion (studying liquid propellant rocket engines), and in founding the Scientific Research Institute of Jet Propulsion. He was an ardent propagandist of rocket technology; in his publications as well as in his own studies and directorships, he emphasized the importance of studying immediate practical goals, such as a manned rocket flight (realized on February 28, 1940, with the SK-9 glider, piloted by V.P. Fedorov). Author

N69-36482*# National Aeronautics and Space Administration, Washington, D.C.
SURVEYOR PROGRAM RESULTS: INTRODUCTION
L. D. Jaffe and R. H. Steinbacher *In its* Surveyor Program Results 1969 p 1–12 refs (See N69-36451 21-30)
Avail: SOD $4.75; CFSTI CSCL 22B

Surveyor spacecraft configurations, their television systems, and measuring instruments are briefly described. Preliminary scientific findings are reviewed and summarized, the results from each mission are compared, and those characteristics of spacecraft operation necessary for understanding the scientific data are described. G.G.

N69-36484*# National Aeronautics and Space Administration, Washington, D.C.
EFFECTS OF LUNAR PARTICLES ON SPACECRAFT MIRROR SURFACES
L. D. Jaffe and J. J. Rennilson *In its* Surveyor Program Results 1969 p 407–412 refs (See N69-36451 21-30)
Avail: SOD $4.75; CFSTI CSCL 22B

Prefiring and postfiring television observations of the gold plating on the Surveyor 5 sensor head was used to determine the cause of a fine lunar particle coating on spacecraft mirror surfaces. After the vernier-engine firing, the image of the sensor head circular plate and of the lunar surface was not visible when the near side of the sensor head was in sunlight. Some image was observed in a part of the side in shadow. A set of wide angle color pictures of the sensor after firing showed that the darker, lower part of the sensor head was covered with lunar material, adhering to a nearly vertical surface; the upper part of the sensor head side was essentially gold, apparently roughened by impact of fine lunar particles. It was concluded that lunar particles thrown by the vernier engines onto the spacecraft surface both sandblast and coat these surfaces. G.G.

N69-36485# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
THE ELDO-PAS NUTATION DAMPER
W. H. de Leeuw 31 Jan. 1968 19 p refs
(RV-18; TR-1) Avail: CFSTI

This report contains the dynamical analysis related in general to a nutation damping device and the analysis of the dimensional scaling relations, which correlate the behavior of the damper in the satellite with experiments performed on the ground. The first results of the experiments carried out are also included. Author

N69-36501*# National Aeronautics and Space Administration, Washington, D.C.
PROJECT GEMINI TECHNOLOGY AND OPERATIONS: A CHRONOLOGY
James M. Grimwood, Barton C. Hacker, and Peter J. Vorzimer 1969 324 p refs
(NASA-SP-4002) Avail: SOD $2.75; CFSTI CSCL 22A

A chronological study of the Gemini project is presented. Historical and background information from the inception of the project is given. Included also are the qualifications set forth for the NASA contractors in the development of the Gemini spacecraft, along with subsequent flight tests. Appendixes covering flight summary data, the program and the mission objectives, vehicle manufacturing and testing histories, and the worldwide tracking network are included. J.M.C.

N69-36511*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROBLEMS INVOLVED IN USING UNMANNED SPACECRAFT SYSTEMS FOR RETURNING SURFACE SAMPLES FROM MARS
F. E. Rosell 1 Nov. 1967 13 p
(Contract NAS7-100)
(NASA-CR-105731; JPL-TM-33-368) Copyright. Avail: CFSTI CSCL 22B

This report summarizes the results of a preliminary look at some of the problems involved in using unmanned spacecraft systems for returning Martian surface samples to earth. Because of limited time available for conducting the study, it was necessary to severely constrain its scope; therefore, these results should not be interpreted as applicable for conditions that lie outside of the assumed constraints. The study identifies and describes four of the more promising mission profiles. Because of the limited depth of the investigation, it was not possible to provide a conclusive answer to the question of feasibility of using unmanned spacecraft systems for returning Martian surface samples to earth. However, the report does conclude that the mission appears promising enough to merit in-depth study. Author

N69-36556*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SATURN, SATURN ILLUSTRATED CHRONOLOGY: SATURN'S FIRST TEN YEARS, APR. 1957–APR. 1967
David S. Atkins 1 Aug. 1968 208 p refs Revised
(NASA-TM-X-61816; MHR-5) Avail: CFSTI CSCL 22B

A history of the development of the Saturn project is presented with pictures of the highlights. The data are presented chronologically from April 1957 through April 1967. F.O.S.

N69-36690# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
NUTATION DAMPER TESTS FOR THE PERIGEE-APOGEE CONFIGURATION OF THE ELDO-PAS

W. H. de Leeuw 10 Oct. 1968 8 p refs
(RV-28) Avail: CFSTI

Tests were performed with a model nutation damper to investigate the damper behavior in relation to the perigee-apogee configuration of the ELDO-PAS. The tests indicated that the influence of the nutation damper on the stability of the assembly is negligible. Author

N69-36693# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
ALIGNMENT OF SENSORS AND NUTATION DAMPER IN THE ELDO/PAS SATELLITE
J. H. de Koomen 26 Mar. 1968 7 p
(RV-21) Avail: CFSTI

The alignment procedure and some relevant satellite structure requirements are given for the opitcal alignment of the attitude control equipment in the satellite. The possibilities of an alignment check on the spinning satellite is also discussed. Author

N69-36724*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
LUNAR ORBITER PROGRAM GUIDANCE AND CONTROL SYSTEM DESIGN SURVEY Final Report
Aug. 1969 206 p refs
(Contract NAS12-2027)
(NASA-CR-86228; D2-114277-2) Avail: CFSTI CSCL 22B

This design survey presents the results of study of the Lunar Orbiter guidance and control system and program documentation. Highlights of the experiences gained from program initiation through the final terminal crash maneuver of L.O. 5 are reported. The things of value to the designer of future spacecraft are emphasized. The evolution of the design was studied and the reasons for changes have been indicated. Considerable effort was made to identify and report the cause for difficulties that occurred. Reasons for success as well as failure are summarized. Author

N69-36728# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
ATTITUDE CONTROL SYSTEM OF THE ELDO-PAS SATELLITE Final Report
W. H. de Leeuw 22 Sep. 1967 30 p
(RV-15) Avail: CFSTI

The dynamics of the ELDO-PAS satellite and the nutation damper are discussed. Author

N69-36732# Bell Aerosystems Co., Wheatfield, N.Y. Rocket and Propulsion Systems Reliability Dept.
SERVICE LIFE PREDICTIONS
Leonard M. Usiak *In* Am. Soc. for Quality Control Reliability and Quality: Teamwork for Prod. Effectiveness 1969 p 35-43 refs (see N69-36726 21-15)
Avail: CFSTI

This paper presents a method for predicting the service life of a system. Procedures for identifying and testing system variables for both operational and non-operational phases of a mission are discussed. Statistical techniques for obtaining service life estimates from variables test data are outlined and the predicted service life of the system is observed to be the shortest of the service life estimates for the family of variables. Author

N69-36786*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MANNED SPACE STATIONS
Robert R. Gilruth *In* School of Aerospace Med. Bioastronaut. and the Exploration of Space Nov. 1968 p 153-177 (see N69-36776 21-04)
Avail: CFSTI CSCL 22B

Reasons for adopting the manned space station concept, basic design requirements, and present earth orbital plans as contained in the Apollo Applications Program are discussed, as well as speculations as to the role of future stations. A detailed overview of the orbital workshop to become operable under the Apollo Applications Program is given. Such a station will contain sufficient volume and support equipment for astronauts to function in a manner more similar to earth environment. This is accomplished by outfitting an S-4B booster stage so that it can be entered after depletion of hydrogen and made into livable quarters. It will then be visited over a period of time by a series of Apollo CSM flights. In addition to continuous medical investigations into human adaptability, a major scientific experiment in solar physics will be conducted from the station. Man's performance at zero gravity over a long period of time can also be evaluated. Future applications of the concept are considered in two areas (1) observational experiments, including astronomy and earth sensing; and (2) on-board experiments in bioscience, biomedicine, and high energy physics. A.C.R.

N69-36891*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF THE MATERIALS DIVISION METEROID SIMULATION FACILITY
R. C. Ruff 26 Sep. 1968 58 p refs
(NASA-TM-X-53787) Avail: CFSTI CSCL 22B

An introduction to the meteoroid hazard and the various methods of meteoroid simulation is presented. The light gas gun and accessory third stage accelerator hypervelocity launcher are compared to other facilities. A detailed description of the operation and instrumentation of the meteoroid simulation facility is presented. The results of firings to date are summarized and the program and simulation capabilities of the facility are discussed. Author

N69-37012# General Dynamics/Convair, San Diego, Calif.
ASSEMBLY AND MAINTENANCE OF LIGHTWEIGHT METALLIC STRUCTURES IN SPACE Final Report, Feb. 1967 - Jul. 1968
Robert R. Brazell and W. C. Thomson Mar. 1969 126 p
(Contract F33615-67-C-1302)
(AD-688266; AFAPL-TR-68-118) Avail: CFSTI CSCL 22/1

The research described herein was intended to expand the base of knowledge about mans capability to handle structural components and to assemble them into a usable structure in the space environment. Emphasis was placed on structures consisting of tubular supporting elements and large surface panels. Separate test activities were conducted to provide basic information for spacecraft designers and mission planners. Optimum, minimum, and maximum sizes and masses for both tubular elements and flat plates were determined. Data were derived empirically, using Convairs large six-degree-of-freedom simulator and neutral buoyancy simulation techniques. Extensive biomonitoring was carried out during testing, on a variety of subjects. Author (TAB)

N69-37030*# National Aeronautics and Space Administration, Washington, D.C.
EFFECTS OF STRUCTURAL FLEXIBILITY ON SPACECRAFT CONTROL SYSTEMS
Apr. 1969 47 p refs
(NASA-SP-8016) Avail: CFSTI CSCL 22B

Selection, design, and evaluation of a spacecraft control system for operation in the presence of a flexible structure are

outlined. Design and flight experiences of four structural configuration categories are reviewed: (1) the compact, near-rigid spin-stabilized body; (2) the compact body with flexibly connected rigid appendages; (3) the compact body with flexible appendages; and (4) the large flexible body with active control during thrust maneuvers. Potential problems are pointed out in design and operation of dual-spin-stabilized spacecraft with flexibility, spin-stabilized spacecraft encountering spin resonance, spacecraft with flexibility in the control loop, spacecraft with multiple controllers, and large vehicles with increased flexibility. Stability and control criteria as well as recommended practices are stated for application in analytical studies, simulation studies, and tests. A listing of space vehicle design criteria documents issued by NASA is included. K.W.

N69-37128# Thiokol Chemical Corp., Ogden, Utah. Astro-Met Div.

THE ECONOMICS OF SOUNDING ROCKET UTILIZATION Final Report, 1 Jun. 1966 – 16 May 1969

Wolfgang Schaechter 16 May 1969 77 p refs

(Contract AF 19(628)-6009)

(AD-689419; AFCRL-69-0221) Avail: CFSTI CSCL 19/7

Analytical methods, that could be used to make scientific sounding rocket procurement and utilization more economically effective, are described. A Figure of Merit comparator, on which sounding rocket procurement and vehicle development decisions can be based, is proposed. The cost optimization of combinations of sounding rocket types for a user agencys vehicle inventory, selected on the basis of the Figure of Merit, is demonstrated. It is shown that optimum combinations of vehicle types can produce significant savings in the overall costs of a sounding rocket inventory. Techniques for predicting mission requirements are discussed, and one of these, polynomial extrapolations of actual utilization histories, is applied to historical utilization data from AFCRL and NASA/GSFC. More sophisticated statistical prediction techniques are examined for their applicability to this problem. Bayesian decision theory is discussed in its potential application to inventory optimization. Method of estimating the cost effectiveness of a proposed sounding rocket vehicle development program are examined. Considerations of success criteria, projected mission requirements, and reliability growth, are included in the guidelines for the cost effectiveness evaluation. Author (TAB)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N69-36022 Michigan Univ., Ann Arbor.

AN APPLICATION OF SINGULAR-PERTURBATION THEORY TO PANEL FLUTTER

John Henry Spriggs (Ph.D. Thesis) 1968 135 p

Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-2391

Through the use of perturbation methods, it is possible to obtain approximate solutions to the eigenvalue problem for panel flutter. Two possible limit processes are considered. The first leads directly to the usual no flutter result. The second, which has not previously been considered, leads to a flutter boundary which agrees with results for thicker panels. Perturbation methods allow replacement of the more difficult eigenvalue problem with a sequence of approximate eigenvalue problems. In so doing, boundary layer phenomena are introduced which must be studied. A preliminary study of the cassical membrane flutter problem suggests the possibility of using a two-variable expansion. Such an expansion procedure is carried out, making use of a nondimensional interior variable and a stretched boundary layer variable measured from the trailing edge. A boundary layer correction is required at the leading edge and is carried out in the usual manner. The frequency is expanded in powers of the small parameter, with successive terms obtained by requiring that the solution have time dependence of the form exp(kt). The study extends the panel flutter boundary to thinner panels than previously considered. These results clarify the paradox concerning the transition of the panel flutter problem from plate-like to membrane-like action. Further, a great reduction in computational difficulty has resulted when panels of moderate thickness are considered. Dissert. Abstr.

N69-36028# Army Materials and Mechanics Research Center, Watertown, Mass.

PROCEEDINGS OF THE ARMY SYMPOSIUM ON SOLID MECHANICS

Sep. 1968 285 p refs Conf. held at Baltimore, 10–11 Sep. 1968

(AD-675463; AMMRC-MS-68-09) Avail: CFSTI CSCL 13/13

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14. A STIFFNESS MATRIX FOR A TRAPEZOIDAL MEMBRANE ELEMENT E. L. Cook and R. E. Chapel (Oklahoma State Univ.) p 189–203 refs (See N69-36040 21-32)

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17. STRESS CONCENTRATION FACTORS IN ANISOTROPIC MATERIALS J. W. Dally (IIT Res. Inst., Chicago, Ill.) and I. Alfirevich (Zagreb Univ.) p 235–253 refs (See N69-36043 21-18)

18. STRESS AND FINITE STRAIN ANALYSIS OF A CIRCULAR RING UNDER DIAMETRAL COMPRESSION A. J. Durelli, V. J. Parks, and L. Chen (Catholic Univ. of Am.) p 255–269 refs (See N69-36044 21-32)

19. STRESS CONCENTRATIONS IN PARTICULATE FILLED COMPOSITE MATERIAL B. E. Ross, J. E. Griffith, and L. Oline (Univ. of S.Fla.) p 271–285 refs (See N69-36026 21-18)

N69-36027# Stanford Univ., Calif.
THERMO-ELASTIC-PLASTIC ANALYSIS AT FINITE STRAIN
E. H. Lee In AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 1–15 refs (See N69-36026 21-32)
Avail: CFSTI

For high pressure loading situations, classical plasticity theory may not be satisfactory since the usual assumption of the total strain being the sum of elastic and plastic components may not apply for non-infinitesimal strain, and thermomechanical coupling influences become important. Kinematics to deal with the finite deformation case are introduced and also a two component thermodynamic model to represent elastic–plastic deformation. One component is reversible thermoelasticity, and the other plastic flow which absorbs some of the plastic work in the generation of crystal imperfections and the rest is dissipated into heat. Author

N68-36033# Pennsylvania State Univ., University Park.
MOMENT-CURVATURE-TIME RELATIONSHIPS FOR MATERIALS IN BENDING
V. H. Neubert and W. G. Brown (USABRL) In AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 79–93 refs (See N69-36026 21-32)
Avail: CFSTI

Results of tests are reported in which moment-curvature-time relationships for materials under dynamic loading were measured directly. Loading is applied by submitting a cantilever beam to a base acceleration. The first quarter cycle of loading drives the material well into the plastic range. Several cycles of unloading and reloading then occur. Physical data for rectangular, mild steel bars is presented in which the levels of initial reduction by cold-rolling varied from zero to fifty percent. The applicability of a particular strain rate law similar to that proposed by Malvern is discussed. Author

N69-36034# Ballistics Research Labs., Aberdeen Proving Ground, Md.
LONG ROD IMPACTS ON FINITE TARGETS
Chester L. Grabarek and Antonio J. Ricchiazzi In AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 95–109 ref (See N69-36026 21-32)
Avail: CFSTI

Deformation-time observations are presented for mild steel rod impacts on finite targets of like material. The plastic front associated with the radial expansion was measured as it progressed toward the rod aft end. The plastic front velocity varies with time from 820 meters/second to 325 meters/second as a function of the striking velocity. From the displacement-time measurements the deceleration of the rod free end during the impact was obtained. The measurements show that the rod free end velocity does not decrease uniformly with time. At striking velocities above the target perforation velocity measurements of the residual rod weight and velocity were obtained. Author

N69-36037# Army Materials and Mechanics Research Center, Watertown, Mass.
LARGE NONSYMMETRIC DEFLECTIONS OF THIN SHELLS OF REVOLUTION
John F. Mescall *In its* Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 143–158 refs (See N69-36026 21-32)
Avail: CFSTI

The geometrically nonlinear behavior of thin shells of revolution undergoing large non-axisymmetric deflections is studied by the user of Sander's equations. A numerical procedure is described which permits the derivation of detailed load-deflection curves in terms of which the stability of the shell may be analyzed. Numerical results have been obtained for the case of uniform pressure on a clamped spherical shell as well as for nonsymmetrical loads. Application of results to problems of physical interest is described. Author

N69-36038# Army Materials and Mechanics Research Center, Watertown, Mass. Applied Mechanics Research Lab.
BUCKLING INSTABILITY OF PRESSURIZED TORISPHERICAL SHELLS
J. Adachi and M. Benicek *In its* Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 159–171 refs (See N69-36026 21-32)
Avail: CFSTI

The buckling behavior of torispherical shells, pressurized internally, was studied by using molded plastic models and shells machined from high strength aluminum and titanium alloys. Nondimensionalized, empirical prediction curves for critical buckling pressure based on tests of molded plastic models were found to provide accurate prediction of the buckling pressures for the carefully machined metal shells. Author

N69-36039# Army Materials and Mechanics Research Center, Watertown, Mass.
MEASURED NONLINEAR DISTRIBUTIONS IN PRESSURIZED TORISPHERICAL SHELLS
M. Benicek and J. Adachi *In its* Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 173–188 refs (See N69-36026 21-32)
Avail: CFSTI

Two thin aluminum torispherical shells, one spun and one machined, were strain gaged and pressurized internally. Strain distributions were measured, stresses computed, and compared with linear and nonlinear theory. Comparisons showed the linear theory to be very conservative in critical areas of the shells, whereas the nonlinear theory showed close agreement with experiment. The stresses in the machined shell behaved in a theoretically predictable manner, but significant inconsistency was observed in the spun shell stresses. Nonlinear strain behavior was carefully recorded for a large number of points. Representative data from the machined shell are provided for further analysis. Author

N69-36040# Oklahoma State Univ., Stillwater.
A STIFFNESS MATRIX FOR A TRAPEZOIDAL MEMBRANE ELEMENT

Everett L. Cook and R. E. Chapel In AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 189-203 refs (See N69-36026 21-32)
Avail: CFSTI

A stiffness matrix is derived for a trapezoidal membrane element by assuming linear displacements within the element. Partitioning of the stiffness matrix allows calculation of the stiffness coefficients in terms of only the direct stresses. The results of a direct stiffness analysis and a force analysis of a small monolithic trapezoidal shear panel are presented. A consistent mathematical model was used for both analyses and the results are essentially identical. The results of an experimental investigation of the same panel are compared with the analytical results. For the smallest sub-element size investigated, the agreement between calculated and measured strains is excellent. Author

N69-36041# State Univ. of New York at Buffalo.
DYNAMIC RESPONSE OF CYLINDRICAL SHELLS TO LATERAL LOAD
John Medige, Ming-Zer Lin, and Herbert Reismann In AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 205-219 refs (See N69-36026 21-32)
Avail: CFSTI

A moderately thick, freely supported cylindrical shell subjected to a sudden, non-axisymmetric lateral loading is analyzed using an improved theory which takes shear deformation and rotatory inertia into account. The radial deflection, stress and moment resultants and axial and hoop stresses are calculated and compared to the corresponding values obtained using the Flügge theory. The deflection and membrane forces are found to differ only slightly, while moment resultants and stresses differ appreciably. These differences become greater for thicker shells. Author

N69-36042# South Dakota School of Mines and Technology, Rapid City.
RESONANT VELOCITIES IN STEADY-STATE COUPLED SHELL FLUID RESPONSE
James E. Russell and George Herrmann (Northwestern Univ.) In AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 221-233 refs (See N69-36026 21-32)
Avail: CFSTI

Steady-state solutions for a load moving with a constant velocity on a beam of cylindrical shell are characterized by critical or resonant velocities. Usually the beam or shell is assumed to be in a vacuum. In this paper, an infinitely long, thin, cylindrical shell is assumed to be submerged in a fluid medium of infinite extent. The effects of the fluid on the resonant velocities are studied. It is found that the presence of the fluid lowers the smallest critical velocity. Author

N69-36044# Catholic Univ. of America, Washington, D.C. Civil Engineering and Mechanics Dept.
STRESS AND FINITE STRAIN ANALYSIS OF A CIRCULAR RING UNDER DIAMETRAL COMPRESSION
A. J. Durelli, V. J. Parks, and L. Chen In AMMRC Proc. of the Army Symp. on Solid Mech. Sep. 1968 p 255-269 refs (See N69-36026 21-32)
Avail: CFSTI

Using a moire, large-strain analysis method, a complete solution is shown of the fields of strain and stress for a circular ring subjected to diametral compression between to flat platens. The isothetics u and v, obtained using 1000 lines per in. gratings, were differentiated photographically by the shifting technique (moire-of-moire). Using the exact finite strain displacement relationship, the Eulerian strains were computed. These results were verified with the isochromatics obtained from a large deformation photoelasticity analysis. The ring was made of a polyurethane rubber which exhibits a linear relationship between natural strain and a newly introduced concept of natural stress. Author

N69-36082# Woods Hole Oceanographic Institution, Mass.
OBSERVATIONS OF STATIC AND DYNAMIC TENSION VARIATIONS FROM SURFACE MOORINGS
Robert C. Millard, Jr. May 1969 45 p refs
(Contract N00014-66-C-0241)
(AD-689335; WHOI-Ref-69-29) Avail: CFSTI CSCL 20/11

Observations of static and dynamic tension amplitude changes in a surface mooring line are presented. A comparison with wind and currents is made. Simple models are used in an attempt to explain the observed relationships. Author (TAB)

N69-36085# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
IMPROVED WHEEL PERFORMANCE ON SAND BY CONTROLLED CIRCUMFERENTIAL RIGIDITY Final Technical Report, 1966-1968
Klaus W. Wiendieck May 1969 77 p refs
(AD-689876; M-69-2) Avail: CFSTI CSCL 13/6

An analysis of experimentally determined stress distributions beneath tires on sand revealed a strong tendency for the normal stresses to be greater in areas of higher-than-average tire rigidity, i.e. along the periphery of the contact patch where the tire rigidity is augmented by tire sidewall stiffness and/or local tire flexing. The question arose as to whether the observed phenomenon could be used advantageously by directly controlling the tire rigidity pattern, and thus favorably influence stress distribution, with the net result of improved tire performance. An experimental wheel was built to test this principle; its performance is described in this report. The control of local tire rigidity was achieved by a system of six nonrotating hydraulic jacks inside the wheel acting against a fixed flexible shoe, along which the inner surface of the tire slid as it rotated. Tests with sand at two strength levels showed that the wheel with favorable rigidity distribution (increasing rigidity to the rear of the soil-wheel interface) developed up to 25 percent more pull than the wheel with unfavorable rigidity distribution. The greater pull was paralleled by an efficiency increase of the same order. These experimental results are explained by theoretical computations based on the variation of assumed stress distribution as a function of the rigidity pattern. The experimental wheel was built to check a principle rather than to be used as a means of locomotion, but the prospect of applying the principle of controlled rigidity in practice is shown to be promising. Author (TAB)

N69-36088# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANICS OF VISCOELASTIC MEDIA
M. I. Rozovski Jan. 1969 100 p refs Transl. into ENGLISH from the publ. "Uprugost i Plastichnost" Moscow, Izd. Itogi Nauki, 1967 p 165-250
(AD-688860; FTD-HT-23-758-68) Avail: CFSTI CSCL 20/11

The state of the art in the theory of viscoelastic solids presented in this review is based on 258 Soviet and non-Soviet publications. The review is devoted to investigations concerning the behavior under load of elastic solids with memory, in which the effect of prior states on the succeeding ones is accounted for by introducing linear and nonlinear functionals. The equations and methods used in solving these problems are critically analyzed, and the materials are divided into four chapters. Author (TAB)

N69-36112# Institut Franco-Allemand de Recherches, St. Louis (France).
BEHAVIOR OF DIFFERENT PROJECTILES FIRED FROM AN ELECTROTHERMAL GUN [SUR LE COMPORTEMENT

DE DIVERS PROJECTILES LANCES AU MOYEN D'UN ACCELERATEUR ELECTROTHERMIQUE]
G. Herbette 17 Dec. 1968 21 p refs In FRENCH; GERMAN summary
(ISL-T-54/68) Avail: CFSTI

Acceleration and impact tests were conducted with 1.5-mm-dia spheres and cylinders at velocities up to 20 km/s. The projectiles were made of various metals, ceramics, polyethylene, Teflon, glass, and polymethyl methacrylate. Impact and cratering were analyzed on targets of aluminum and Duralumin. The test results indicate that the conventional metals and the opaque organic materials perform poorly at high-velocity acceleration; decidedly better results were obtained with transparent (glass, polymethyl methacrylate) and pyrolytic materials (titanium, ceramics). Transl. by K.W.

N69-36192*# Aerojet-General Corp., Sacramento, Calif. Research and Technology Dept.
STRESS-WAVE ANALYSIS TECHNIQUE STUDY ON THICK-WALLED TYPE A302B STEEL PRESSURE VESSELS, JULY 1968-JULY 1969
C. E. Hartbower, F. J. Climent, C. Morais, P. P. Crimmins Jul. 1969 84 p refs
(Contract NAS9-7759)
(NASA-CR-101887) Avail: CFSTI CSCL 20K

The results of investigations to determine relationships between stress wave emission characteristics and subcritical crack growth in Type A302, grade B alloy steel are presented. Stress wave emission characteristics which can be used as precursors for instability (failure) for unhydrogenated and hydrogenated material tested in air and 3% NaCl-water environments are discussed. The fractur behavior of unhydrogenated and hydrogenated A302B steel in these environments is also described. The results of background noise measurements presented and the feasibility of monitoring subcritical crack growth in Type A302B steel determined by correlating these results with the laboratory stress wave emission fracture test data. Stress wave emission attenuation data are also presented and employed to determine sensor patterns for pressure vessels. Author

N69-36220*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE DYNAMIC RESPONSE OF A FLEXIBLE ROTOR BLADE TO A CONCENTRATED FORCE MOVING FROM TIP TO ROOT
John F. Ward Washington Sep. 1969 43 p refs
(NASA-TN-D-5410) Avail: CFSTI CSCL 20K

An approximate analytical solution is presented of the dynamic response of a flexible rotor blade to a radially moving force. The results are interpreted specifically in terms of helicopter rotor-blade vibration chracteristics associated with tip-vortex impingement. These results indicate that low-frequency-mode resonant amplification of repetitive-impulse loadings may be encountered at moderate to high forward speeds on lifting rotor systems. The resonant conditions are encountered in sequence with increasing forward speed. For blades of conventional design, the resonant frequencies are encountered at noninteger multiples of rotor rotational speed. Author

N69-36332*# National Aeronautics and Space Administration, Washington, D.C.
COMPUTATION OF VIBRATIONS OF VARIABLE-THICKNESS DISKS BY THE RITZ METHOD
A. V. Karpov *In its* Invest. of Variation and Stability of Aircraft Eng. Components Aug. 1969 p 83-88 refs (See N69-36326 21-02)
Avail: CFSTI CSCL 20L

The present paper considered a variational method for designing variable thickness disks with a rim and radial ribs. The Ritz method, using functions approximating the actual thickness of the disk, was used for vibration design of intricately shaped disks. Functions for approximating the thickness of intricately shaped disks were given. The method presented is suitable for disks with a rim and radial rib thickness conforming to the concept of a thin plate. Author

N69-36334*# National Aeronautics and Space Administration, Washington, D.C.
STABILITY OF THREE-LAYER CYLINDRICAL SHELLS BEYOND THE ELASTIC LIMIT
V. V. Serdyukov *In its* Invest. of Vibration and Stability of Aircraft Eng. Components Aug. 1969 p 93-104 refs (See N69-36326 21-02)
Avail: CFSTI CSCL 20K

The present paper examines the stability of cylindrical shells consisting of two outer layers interconnected by a filler and subjected to a normal pressure and axial force when the stresses in the bearing layers exceed the proportional limit. It is assumed that the thickness of the bearing layers and their temperatures are different and that they may be made from different materials. This study is based on: (1) the theory of plastic deformations; (2) the principle of continuing loading; and (3) the theory of shells with large radii of curvature. Author

N69-36336*# National Aeronautics and Space Administration, Washington, D.C.
STABILITY OF THREE-LAYER CYLINDRICAL SHELLS IN THE ELASTIC AND INELASTIC REGIONS
I. A. Yefimov *In its* Invest. of Vibration and Stability of Aircraft Eng. Components Aug. 1969 p 111-117 refs (See N69-36326 21-02)
Avail: CFSTI CSCL 20K

The present paper considers the small scale stability beyond the elastic limit of three-layer cylindrical shells with a filler made of longitudinal and transverse corrugations. These also include three-layer shells in which the ribs of the corrugation lie along a low-pitch (helix) subjected to separate or combined action of several kinds of loads. It is assumed that a purely plastic condition exists in the bearing layers at the instant of buckling and that the filler behaves elastically. The filler is regarded as continuous and orthotropic, capable of taking up longitudinal forces and moments (the resistance of the corrugation to longitudinal forces and moments were not considered. the bearing layers are isotropic, have the same thickness and identical mechanical characteristics. The substantial difference between our work and that based on the theory of shallow shells is the fact that in considering the deformation of the filler in the circumferential direction it does not consider the fact that the shell (actually) is not shallow, which in the final count increases accuracy of the results for sufficiently long shells. Author

N69-36357*# Philco-Ford Corp., Newport Beach, Calif.
SYNTHESIS OF OPTIMUM STRUCTURAL DESIGNS FOR CONICAL AND TENSION SHELL MARS ENTRY CAPSULES
Gerald A. Cohen, Richard M. Foster, and James R. Dowty Washington NASA Aug. 1969 101 p refs
(Contract NAS1-5554-4)
(NASA-CR-1365) Avail: CFSTI CSCL 20K

Optimum design procedures are developed for lightweight, low ballistic coefficient entry capsules of both sandwich and ring-stiffened construction. These procedures are used to obtain specific point designs for 120° blunted cone and 0A.833 tension

shell capsule configurations. Aeroshell and base ring weight correlations are presented for the 120° sandwich cones. The effects of variation in structural temperature, ballistic coefficient, peak dynamic pressure, capsule size, and structural material are considered. Author

N69-36389# Institut Franco-Allemand de Recherches, St. Louis (France).
STATIC STUDIES ON THE BEHAVIOR OF HOMOGENEOUS RESIN-CONCRETE PLATES UNDER CONSTANT LOADING. COMPARISON WITH THE RESULTS OF DYNAMIC TESTS IN A SHOCK TUBE [ESSAIS STATIQUES DE TENUE SOUS CHARGES UNIFORMES DE PLAQUES HOMOGENES EN BETON DE RESINE. COMPARAISON AVEC LES RESULTATS DYNAMIQUES OBTENUS AU TUBE A CHOC]
Ch. Johe and Chr. Thery 30 Dec. 1968 25 p In FRENCH; GERMAN summary
(ISL-T-60/68) Avail: CFSTI

Concrete plates with epoxy or polyester resins as binders were subjected to static loads that were increased to the point of crack initiation and fracture. Deformation and flexing up to fracture were measured. Parallel with these experiments, dynamic control tests were performed in a shock tube. Results obtained by the various tests are compared with predicted theoretical values. Tensile crack initiation was found to set in at loads of approximately 200 bar, while fracture occurred at loads considerably higher. Transl. by K.W.

N69-36384# Institut Franco-Allemand de Recherches, St. Louis (France).
TEST REPORT ON THE BEHAVIOR OF A REINFORCED-CONCRETE SLAB UNDER PULSED PRESSURE LOAD [COMPTE RENDU D'ESSAIS DE TENUE AU SOUFFLE D'UNE DALLE EN BETON ARME]
C. Thery, G. Gerspacher, and G. Mosser 28 Nov. 1967 28 p In FRENCH; GERMAN summary
(ISL-T-39/67) Avail: CFSTI

Evaluated was the pressure shock resistance of steel cement plates to loads of about 35 bar. Experimental results showed that a lightweight plate of steel, welded to reinforcing cement and deeply bonded at various points, exhibited extremely strong adhesion and pressure shock resistance. However, the plate was slightly damaged by the buckling of the outer layer. This effect can be avoided if the upper part of the classical armature is replaced by rods with oval diameters which possess a greater bending stiffness. The evaluation of such a plate was described and the obtained results were satisfying. Transl. by G.G.

N69-36393# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
THE STABILITY OF A CLAMPED SHALLOW ARCH SUBJECTED TO IMPULSIVE LOADING
Maxwell C. Chung and Charles D. Babcock, Jr. Mar. 1969 32 p refs
(Grant AF-AFOSR-1424-68)
(AD-688225; AFOSR-69-0878TR) Avail: CFSTI CSCL 13/13

Clamped circular aluminum arches have been explosively loaded using a spray deposited light ignited explosive (Silver Acetylide-Silver Nitrate). Using high speed photography and computerized data reduction, a detailed time history of the arch deflection has been obtained. This deflection was fitted with mode shapes in order to display the motion graphically. The experimental data shows that the clamped arch does not have a jump in response with increasing load level, but a transition from small displacement response to a large displacement response over a sizable range of load level. Author (TAB)

N69-36422# Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
STRESS AND DEFLECTION EQUATIONS FOR ANALYZING SHELLS WITH AXIALLY SYMMETRIC GEOMETRY AND LOADING-THEORY AND COMPUTER PROGRAM
Carl W. Larson, Bruce G. Knutelsky, and Robert G. Salamon Apr. 1969 78 p refs
(AD-688135; PA-TR-3762) Avail: CFSTI CSCL 13/13

This report gives the equations for solving the moments, shears, stresses and deflections for axially symmetric shells with axially symmetric loadings at each major discontinuity. These equations have all been included in a FORTRAN IV program for the IBM 360-65 digital computer, which has simplified the calculation of the shell stresses for projectiles, rockets, and missiles. A good deal of engineering experience is necessary to section the shell properly, to obtain equivalent sections, and to apply the loading as realistically as possible. The results are accurate only for small deflections and in the elastic region of the material. Applied to any case for which these assumptions are not valid, the formulas will yield results which at best are approximate. Author (TAB)

N69-36426*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.
INFLUENCE OF A RIGID TOP MASS ON THE RESPONSE OF A PRESSURIZED CYLINDER CONTAINING LIQUID, PART 1 Final Report
Daniel D. Kana and Wen-Hwa Chu 2 Jun. 1969 38 p refs
(Contract NAS8-21282; SwRI Proj. 02-2332)
(NASA-CR-102232) Avail: CFSTI CSCL 20K

The influence of a localized rigid mass was determined for the longitudinal response of a model vehicle propellant tank. A theoretical analysis is conducted to predict the dynamic response of a simplified model consisting of a partially liquid filled cylinder which has a rigid flat bottom, an internal ullage pressure, and a rigid top mass. Donnell shell equations, along with additional terms to allow for geometrical nonlinearities, are used to determine natural frequencies and forced axisymmetric response of the model. Numerical results are compared with experimental observations for a range of several significant parameters. It is found that strong coupling occurs between the motion of the shell, liquid, and top mass over a wide portion of this range. Author

N69-36427*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.
DYNAMIC STABILITY OF CYLINDRICAL PROPELLANT TANKS, PART 2 Final Report
Daniel D. Kana and Wen-Hwa Chu 2 Jun. 1969 71 p refs
(Contract NAS8-21282; SwRI Proj. 02-2332)
(NASA-CR-102233) Avail: CFSTI CSCL 20K

Dynamic instability and associated parametric resonance is a dominant form of response in a longitudinally excited cylindrical shell containing liquid. In order to assess the significance of such responses in a space vehicle propellant tank, the present paper is devoted to a theoretical and experimental study of their occurrence in a cylindrical shell system which includes the influences of axial preload, ullage pressure, partial liquid depth, and a finite top impedance. Donnell shell theory along with a modified Galerkin procedure is utilized to formulate equations which govern the stability of perturbations superimposed on an axisymmetric initial state of response. Stability boundaries are computed for a range of parameters affecting the region of principal parametric resonance and are compared with experimental results. It is found that liquid depth, top impedance, and ullage pressure have a strong influence on stability, while the effects of axial preload are relatively insignificant. Author

N69-36435*# Aerojet-General Corp., Sacramento, Calif. Advanced Materials Technology Section.
MONITORING OF CRACK GROWTH IN Ti-6-Al-4V ALLOY BY THE STRESS WAVE ANALYSIS TECHNIQUE
W. G. Reuter, A. T. Green, C. E. Hartbower, and P. P. Crimmins Dec. 1968 66 p refs
(Contract NAS9-7759)
(NASA-CR-101888) Avail: CFSTI CSCL 20K

The results of investigations to establish stress - wave analysis technique (SWAT) system parameters for the monitoring of thin-walled Ti-6A1-4V pressure vessels such as the Apollo SPS tank are presented. Sensor attachment techniques which overcome previous problems encountered when bonding cement was used to attach the sensor to the test article are described. Stress wave emission characteristics which can be employed as precursors of failure in air, distilled water inhibited with sodium dichromate (500 ppm) and methyl alcohol environments were determined, and a SWAT system possessing sufficient sensitivity to detect and monitor stress wave emissions associated with subcritical crack growth is discussed. Critical stress intensity data and relationships between applied stress intensity and failure time for the various material thicknesses (0.030 and 0.060 in.) and environments investigated are presented. Application of the results to the proof testing of critical tankage is discussed. Author

N69-36558# Rubber Research Inst. Tno, Delft (Netherlands).
EVALUATION OF USED INFLATABLE LIFE BOATS OF SIKORSKY HELICOPTERS [BEOORDELING VAN GEBRUIKTE DRIJVERLICHAMEN VANDE HOOFDWIELEN VAN SIKORSKY HELICOPTERS]
29 May 1969 6 p In DUTCH
(Rept-257/69) Avail: CFSTI

Two used inflatable life boats manufactured in 1963 and covered by a five-year warranty by the manufacturers were tested after expiration of the warranty period. A new sample of the material (two layers of polyamide cloth coated with chloroprene rubber) was tested as a control. The tests covered visual inspection, leakage, burst pressure, tensile strength, adhesion of material layers and coatings, and strength of seams. The specimens passed all tests and were found fit for several more years of service. Transl. by K.W.

N69-36600# Aerospace Corp., San Bernardino, Calif. Operations.
FINITE ELEMENT STRESS ANALYSIS OF POROUS MEDIA
James G. Crose 23 May 1969 78 p refs
(Contract F04701-68-C-0200)
(AD-688250; TR-0200(S4816-76)-1; SAMSO-TR-69-152) Avail: CFSTI CSCL 20/11

The theory of deformation of porous elastic solids by M. A. Biot is specialized for those cases where deformations do not significantly alter the fluid flow characteristics of the porous solid. Assuming that porosity and fluid pressure are known functions of the body coordinates, the theory is combined with the finite element stress analysis method. After further specialization to the case of axial symmetry, the SAAS II (Stress Analysis of Axisymmetric Solids, Version II) finite element computer program is modified to yield solutions to the subject class of problems. The method is then verified with solutions to example problems for which exact answers can be obtained. A listing of the three affected subroutines and instructions for their use are given. For the convenience of current SAAS II users, a summary table of program changes is included. Author (TAB)

N69-36674# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
ELASTOSTATIC LOAD TRANSFER TO A HALF-SPACE FROM A PARTIALLY EMBEDDED AXIALLY LOADED ROD
Rokuro Muki and Eli Sternberg Apr. 1969 45 p refs
(Contract Nonr-220(58))
(AD-688162; TR-18) Avail: CFSTI CSCL 13/13

This investigation is concerned with the diffusion of an axial load from a bar of arbitrary uniform cross-section that is immersed in, up to a finite depth, and bonded to a semi-infinite solid of distinct elastic properties. The bar is perpendicular to the plane boundary of the embedding medium. The determination of the desired resultant force in the submerged bar-segment is reduced to a Fredholm integral equation by means of an approximative scheme developed and tested earlier in connection with a more elementary three-dimensional load-transfer problem. Extensive numerical results illustrating the decay of the bar-force, appropriate to various choices of the governing geometric and material parameters, are presented for the particular case of a bar of circular cross-section. Author (TAB)

N69-36681# Defence Research Establishment Suffield, Ralston (Alberta).
THE BEHAVIOR OF TWO SIMPLE FRAMED STRUCTURES UNDER BLAST LOADING
B. R. Long Nov. 1968 15 p refs
(SUFFIELD MEMO-110168) Avail: Issuing Activity

This report contains a preliminary presentation of results obtained from testing two simple framed structures on Operation Prairie Flat, which involved the detonation of five hundred tons of TNT at the Defence Research Establishment Suffield in August 1968. These structures had previously been tested on Events 6 and 1A of the Distant Plain trial series. In the current test the structures were exposed to a 12.0 psi incident shock wave. The theoretical analysis used was found to predict displacements adequately but did not give accurate stress resultants, presumably because of its inability to simulate the nonlinear response of the structures in this test. Author

N69-36746# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
THE SOLID WEDGE FINITE ELEMENT FOR STRESS ANALYSIS
T. K. Hellen Feb. 1969 17 p refs
(RD/B/N1305) Avail: CFSTI

A wedge-shaped element containing fifteen corner and midside nodes suitable for use in three dimensional structures is presented. The element has been incorporated in the C.E.G.B. general stressing system, called SAFE, and is designaged EZ45. The element is expected to be used mainly in conjunction with the solid brick element with twenty corner and midside nodes, currently available in SAFE and designated EZ60. Author

N69-36809# Army Weapons Command, Rock Island, Ill. Systems Analysis Directorate.
OPTIMAL DESIGN OF ELASTIC STRUCTURAL ELEMENTS Final Technical Report
Edward J. Haug, Jr., Tommy D. Streeter, and Steven R. Newell Apr. 1969 91 p refs
(AD-688139; SY-R1-69) Avail: CFSTI CSCL 13/13

The class of problems treated falls into the rapidly developing field of optimal structural design. A structure is initially laid out with its geometry fixed but with the distribution of material in the elements left to the designers choice. The amount and distribution of material is chosen so that the structure performs some function and is best in some sense. The examples treated in this report take minimum weight as their optimality criterion. A broad class of optimal design problems is first formulated as an optimal control problem. Two methods of solving this class of problems are then presented and their application to optimal design problems is

discussed. Three optimal design problems are formulated and solved in detail. These problems contain many of the features expected of real-world problems and illustrate the power of computational methods which can be applied for their solution. Author (TAB)

N69-36926# Netherlands Research Centre TNO for Shipbuilding and Navigation, Delft. Dept. of Shipbuilding.
CYLINDER MOTIONS IN BEAM WAVES
J. H. Vugts (Delft Univ. of Technol., Netherlands) Dec. 1968 25 p refs
(TDCK-52704-3; Rept-115-5) Copyright. Avail: Issuing Activity

For the two-dimensional case the motion of a body in waves is formulated mathematically. The coupled roll-sway performance is analyzed. Coupling coefficients and the vertical position of the center of gravity play an important role in the ultimate effects. The theoretical predictions are compared with experiments in a small tank. Author

N69-36971# Rome Univ. (Italy). Inst. of Mathematics.
REVIEW OF SOME RESULTS CONCERNING EIGENVALUE PROBLEMS AND CONNECTED TOPICS Final Scientific Report, 1 Feb. 1968–31 Jan. 1969
Gaetano Fichera 31 Jan. 1969 22 p refs
(Grant AF-EOAR-68-0020)
(AD-688912; ARL-69-0020W) Avail: CFSTI CSCL 20/11

Work done under Grant EOAR 68-0020 is reviewed. It concerns eigenvalue problems connected with the following physical or technical topics: (1) axially symmetric vibrations of an incompressible elastic sphere clamped at its boundary. (2) transverse vibrations for a wedge-shaped, simply supported beam. (3) proper vibrations of a circular membrane fixed at the boundary. (4) eigenvalue problem concerning heat flow. (5) I-shaped membrane. (6) eigenvalue problems for plane elastic systems. Author (TAB)

N69-36980# Whittaker Corp., San Diego, Calif. Research and Development Div.
APPLICATION OF MICROMECHANICS TO JOINTS AND CUTOUTS Final Technical Report, 7 Jun. 1967 – 7 Jan. 1969
Alberto Puppo and Juan Haener Ft. Eustis, Va. Army Aviation Mater. Labs. Apr. 1969 81 p refs
(Contract DAAJ02-67-C-0093)
(AD-688168; MJO-323; USAAVLABS-TR-69-25) Avail: CFSTI CSCL 20/11

The stress distribution in loop and bolt joints made of composite materials is studied using analytical and experimental methods. Also, the stress concentration in orthotropic composite sheets with a circular hole is studied. The numerical technique to evaluate the stresses and displacements is described. Simple design formulas to compute the stresses at critical regions are developed. A procedure of structural design is delineated and applied to specific cases. Experimental results obtained by testing composite joints are reported. Stress distribution tests were performed using the photoelastic technique. Failure location and ultimate loads for several composite joints are shown. This report contains the analysis of the stress concentration that appears around a circular hole in an orthotropic composite sheet under simple tension and simple shear loadings. Author (TAB)

N69-37020# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
AN EXPERIMENTAL STUDY OF THE UNSTEADY FORCES CAUSING VORTEX-EXCITED OSCILLATIONS OF A CIRCULAR CYLINDER
Bryan Rowell Pearce (M.S. Thesis) Jan. 1969 78 p refs
(Contract Nonr-3963(31))
(AD-688934; T-518) Avail: CFSTI CSCL 8/3

The amplitude and frequency of a circular cylinder undergoing vortex-excited oscillations are measured and presented. From this the oscillating exciting forces and lift coefficients are calculated. The lift coefficient and oscillating frequency are non-dimensionalized in terms of equivalent data for a stationary cylinder and plotted. This is compared to other data. Author (TAB)

N69-37127# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EVALUATION OF NUMERICAL DESIGN PARAMETERS
Yu. P. Zaichenko 31 Jan. 1969 9 p Transl. into ENGLISH from Avtomatyka (Kiev), v. 13, no. 6, 1967 p 23 – 27
(AD-689307; FTD-HT-23-823-68) Avail: CFSTI CSCL 13/13

The problem of evaluating the numerical parameters of structures on the basis of other already known and completed structures as standards is investigated. A method for the adoptation of graph coupling coefficients based on the procedure of stochastic approximation is proposed for the solution of this problem. Two variants of an algorithm – one with a determinate sequence of coefficients and the other with a random sequence satisfying certain limitations--are compared. The results of experimental tests of the proposed algorithms are presented with regard to the specific problem of evaluating the parameters of an excavator. Author (TAB)

N69-37154# Notre Dame Univ., Ind. Coll. of Engineering.
INELASTIC AXISYMMETRIC BUCKLING OF RING STIFFENED CYLINDRICAL SHELLS UNDER EXTERNAL PRESSURE
Lawrence H. N. Lee and Lawrence M. Murphy May 1969 99 p refs
(Contract N00014-68-A-0152)
(AD-689382; Themis-UND-69-2) Avail: CFSTI CSCL 13/13

The effects of prebuckling deformation caused by the ring constraints on the inelastic stability of ring stiffened cylindrical shells under external-pressure and deformed axi-symmetrically are studied. By Druckers postulate of positive work in plastic deformation, a modified incremental theory of plasticity on the stress-strain relationships expressed in terms of Kirchhoff stress and Green strain rates is developed. Furthermore, a variational principle in Lagrangian descriptions and for quasi-static problems of finite plasticity is developed and employed to solve the problem. Author (TAB)

N69-37172# Oak Ridge National Lab., Tenn.
PLASTIC DEFORMATION OF CIRCULAR FOILS UNDER SHOCK LOADING
Lawrence Dresner 27 Jan. 1969 25 p refs Sponsored by AEC (ARPA Order 907)
(AD-689389; ORNL-TM-2485) Avail: CFSTI CSCL 13/13

The report discusses the dynamic behavior of rigidly clamped, plastically yielding membrane struck by a head-on shock wave. TAB

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N69-36061# Cekmece Nuclear Research Center, Istanbul (Turkey).
THERMODYNAMIC FUNCTIONS IN NUCLEAR RESEARCH
M. Talat Erben May 1969 16 p refs
(CNAEM-65) Avail: CFSTI

CONTENTS:

1. THERMODYNAMIC FUNCTIONS AS PARTICULAR CASES OF A SINGLE GENERATING FUNCTION M. Talat Erben p 2–5 (See N69-36062 21-33)

2. CYCLIC PROPERTIES OF THERMODYNAMIC FUNCTIONS M. Talat Erben p 6–12 refs (See N69-36063 21-33)

N69-36062# Cekmece Nuclear Research Center, Istanbul (Turkey).

THERMODYNAMIC FUNCTIONS AS PARTICULAR CASES OF A SINGLE GENERATING FUNCTION

M. Talat Erben *In its* Thermodyn. Functions in Nucl. Res. May 1969 p 2–5 (See N69-36061 21-33)

Avail: CFSTI

The equation for total entropy change is derived for a closed system in mechanical and thermal equilibrium, with an infinitesimal irreversible change occurring. It is shown that for changes taking place under constant pressure or at constant volume, the function derived becomes a characteristic thermodynamic property of the system. The thermodynamic generating function is considered in these particular cases: (1) the internal energy as the generating function; (2) the Helmholtz free energy as the generating function; (3) the Gibbs free enegy as the generating function; (4) the enthalpy as the generating function; and (5) the entropy as the generating function. F.O.S.

N69-36063# Cekmece Nuclear Research Center, Istanbul (Turkey).

CYCLIC PROPERTIES OF THERMODYNAMUC FUNCTIONS

M. Talat Erben *In its* Thermodyn. Functions in Nucl. Res. May 1969 p 6–12 refs (See N69-36061 21-33)

Avail: CFSTI

The thermodynamic variables and the thermodynamic functions are arranged in a circular diagram which is of great mnemonic utility. By means of this diagram it is shown that several thermodynamic relations can be deduced from a single one simply by circular permutation. Author

N69-36080# Naval Ordnance Lab., White Oak, Md. Air-Ground Explosives Div.

OPTICAL SPECTRA PRODUCED BY 13-GM PENTOLITE SPHERES IN SEVERAL GASES AT ATMOSPHERIC PRESSURE

K. W. Reed and L. Rudlin 12 Feb. 1969 55 p refs

(AD-689354; NOLTR-69-37) Avail: CFSTI CSCL 19/1

Observations of the luminosity created by 13-GM explosions in air, O2, and N2 have been made with a time-integrated spectograph and with a microsecond-resolution photodiode. Incomplete identification of the spectral species suggests a wide range or excitations in the three gases from low-energy forbidden O2-band radiation to ionized N2-radiation. The source of these excitations has not been proven, but the circumstantial evidence suggests that explosion particles produce the luminosity during collisions with the ambient gas. Author (TAB)

N69-36137 Princeton Univ., N.J.

HETEROGENEOUS IGNITION OF METALS: MODEL AND EXPERIMENT

Arthur Mc Leod Mellor (Ph.D. Thesis) 1968 378 p

Avail: Univ. Microfilms: HC $17.10/Microfilm $4.85 Order No. 69-2550

A physical model is presented, compared with other theories of ignition, and finally tested by detailed experimentation in an induction furnace facility. The model postulates that the ignition temperature, at which a flame appears, will exceed both the critical temperature, at and above which sample self-heating is possible, and the transition temperature, which reflects the protective ability of the product film. Furthermore, the minimum possible ignition temperature of any metal-oxidizer system is the transition temperature appropriate to the particular product film. Because the transition temperature is relatively independent of environmental conditions, and because this temperature can be estimated from the metal oxidation literature in many cases of interest, it then is an important and useful design criterion for efficient ignition of metals. Only if the transition temperature is exceeded can ignition and combustion occur. Both experimental results on metal ignition available in the literature and of the present investigation indicate that the present model is much more general than other theories of metal ignition and is able to correlate ignition data in a completely self-consistent manner. Dissert. Abstr.

N69-36229# Institut Franco-Allemand de Recherches, St. Louis (France).

OPTIMIZING THE BALLISTIC USE OF HIGH-EXPLOSIVES (LINER-PROJECTION AND SHAPED-CHARGES) [OPTIMISATION DE L'EMPLOI BALISTIQUE DES EXPLOSIFS (PROJECTION D'UN REVETEMENT ET CHARGES CREUSES]

M. Defourneaux 12 Dec. 1968 55 p refs In FRENCH; ENGLISH and GERMAN summaries

(ISL-T-65/68) Avail: CFSTI

There are many principles currently admitted to classify high-explosives, but none of them is suitable–at least directly– to define the fitness of a high-explosive to ballistic uses, i.e. to the projection of inert media. The aim of this paper is to find the principle of a classification of high-explosives intended for such uses, and to define coefficients through which this classification may be established. Shaped-charges present a particular case of ballistic use of a high-explosive, due to the existence of limiting geometrical conditions beyond which there is no jet formation. These conditions being taken in account, a particular coefficient is defined for high-explosives to be used in shaped-charges, which is the value of the maximum kinetic energy the jet of such a charge is able to reach, under certain conditions. Author

N69-36284# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

THE CLASSICAL LENNARD-JONES SOLID ABOVE THE TRIPLE POINT TEMPERATURE

Jean-Pierre Hansen Jul. 1969 14 p refs

(LPTHE-TH-69/46) Avail: CFSTI

Monte Carlo results for the equilibrium thermodynamic properties of classical Lennard–Jones systems in the solid phase are presented in the temperature range between the triple point and about twice the critical temperature. The empirical Lindemann melting law is shown to hold in the temperature range considered. A comparison is made between the exact Monte Carlo results and the free volume results. First-order quantum corrections are finally computed and shown to give an important contribution to the free energy and the pressure in the vicinity of the triple point. Author

N69-36299*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A PROCEDURE FOR RAPID COMPUTATION OF EQUILIBRIUM CHEMICAL COMPOSITION AND THERMODYNAMIC PROPERTIES OF THE GENERALIZED ARGON-NITROGEN-OXYGEN-HYDROGEN GAS SYSTEM

Vincent R. Mascitti Washington Sep. 1969 32 p refs

(NASA-TN-D-5416) Avail: CFSTI CSCL 20M

A procedure is described for the rapid computation of the equilibrium chemical composition and thermodynamic properties of the generalized argon-nitrogen-oxygen-hydrogen gas mixture system for non ionized conditions. The procedure employs a variation of

the Newton iteration scheme to solve for chemical composition. The generalized model reduces to the hydrogen-air, hydrogen-oxygen, pure hydrogen, and equilibrium air systems. A computer program listing of the calculation procedure for this gas model is presented. Author

N69-36322# Institut Franco-Allemand de Recherches, St. Louis (France).

PROPAGATION OF A DETONATION OR COMBUSTION ALONG AN INERT SURFACE AND NEAR THIS SURFACE [PROPAGATION D'UNE DETONATION OU COMBUSTION LE LONG D'UNE SURFACE INERTE ET AU VOISINAGE DE CETTE SURFACE]

M. Defourneaux 2 Apr. 1968 32 p refs In FRENCH; GERMAN summary

(ISL-T-5/68) Avail: CFSTI

When a detonation or combustion propagating in a reactive medium with constant velocity D reaches a surface S that separates the reactive medium from an inert medium, the successive detonation or combustion surface (Σ_t) will intersect with the surface (S) in curves (F_t). This study concerns the progression of (Σ_t)and (F_t), which is quite different for the protected and the exponential part of (S) with regard to the initial detonation or combustion surface. In the first case, the detonation or combustion expands with the velocity D along a group of geodetic lines (G) on (S) whose orthogonal trajectories are the curves (F_t). The curves (Σ_t) are formed by the total of the evolving geodetic lines (G_t). In the second case, the surfaces (Σ_t) are parallel to the initial surface (Σ_o). The curves (F_t) generally cannot be characterized on (S). The detonation or combustion propagates along (S) at a rate that is variable and always greater than D. Transl. by K.W.

N69-36375# Institut Franco-Allemand de Recherches, St. Louis (France).

EXPLOSIVES HAVING HIGH MECHANICAL STRENGTH, PART 1 [SPRENGSTOFFE MIT HOHER MECHANISCHER FESTIGKEIT (I. MITTEILING)]

W. Kegler and A. Baumann 5 Jan. 1968 46 p refs In GERMAN; FRENCH summary

(ISL-T-1/68) Avail: CFSTI

Evaluated were the following three production methods for explosive charges with plastic binders for better cohesion: (1) castings; (2) vacuum impregnation; and (3) isostatic pressing. Hexogen and octogen were used as explosives and polyester and methaacrylicacid methyl ester were used as unsaturated plastics. About 100 experimental products, obtained by above described methods, were studied for the mechanical and pyrotechnical properties. Results showed that (1) castings with methaacrylicacid-methylester as binders formed charges with 80 to 85% explosive components; their pressure stabilities were between 620 and 720 kp/cm^2 and their detonation velocities at a density of about 1.63 g/cm^3 were about 7900 m/s; (2) vacuum impregnation formed charges with methaacrylicacid methylesters of pressure stabilities between 470 and 520 kp/cm^2 and with unsaturated polyesters between 500 and 600 kp/cm^2. Their fatigue strength at 108 kp/cm^2 was 3 to 5 times larger than for casted charges; and (3) isostatic pressure forming with 1 to 10% binding substances obtained charges of 115 kp/cm^2 for unsaturated polyester and 450 kp/cm^2 for methaacrylicacid methylester as binders; their fatigue strengths were between 30 and 75 kp/cm^2. Transl. by G.G.

N69-36381# Institut Franco-Allemand de Recherches, St. Louis (France).

TEMPERATURE MEASUREMENTS IN THE WAKE OF CYLINDRICAL PROJECTILES CAPPED WITH AN ALUMINUM LAYER [TEMPERATURMESSUNGEN IN NACHLAUF VON MIT ALUMINIUMPLAETTCHEN VERSEHENEN ZYLINDERGESCHOSSEN]

H. Mach and H. Lehr 19 Jul. 1967 31 p refs In GERMAN; FRENCH summary

(ISL-T-28/67) Avail: CFSTI

Cylindrical polycarbonate and polypropylene projectiles were fired from a powder gun in argon at various pressures. The velocities were about 2700 m/s. Aluminum disks or caps were fixed on the projectiles (in some cases also Cd, Cu, or Ti disks) to produce luminous metal vapor at high stagnation temperatures. For Al, the intensity ratio of two doublet lines in the ultraviolet was used successfully to measure the excitation temperature of the Al vapor in the wake up to six projectile lengths behind the stagnation zone. The optical thickness of the radiating gas was separately determined. The temperature in the stagnation zone was approximately 8000° K and dropped to circa 4000° K over the length of the wake. Transl. by KW.

N69-36385# Institut Franco-Allemand de Recherches, St. Louis (France).

EXPERIMENTAL STUDY OF THE HYPERSONIC WAKE OF AN 8-mm SPHERE ABLATING IN AIR AT PRESSURES OF 10 AND 15 TORR, USING AN IMAGE CONVERTOR CAMERA [ETUDE EXPERIMENTALE PAR CAMERA ELECTRONIQUE DU SILLAGE HYPERSONIQNE D'UNE SPHERE DE 8 mm EN ABLATION DANS L'AIR A 10 ET 15 MM HG]

J. Vauvrecy and H. Fagot 10 Jan. 1969 59 p refs In FRENCH; GERMAN summary

(ISL-T-3/69) Avail: CFSTI

The viscous wake behind an 8 mm polycarbonate sphere, traveling at 5.5 km/s and at a pressure of 10 to 15 torr in air, was photographed by a television camera up to 100 caliber behind the projectile. Photographs showed that wake properties depended on pressure variations. At about 15 torr the characteristic wake turbulences observed 4 caliber behind the projectile corresponded to the transfer from laminar to turbulent flow. The flow became laminar at about 10 torr pressure. Wake measurements were used to determine the wake distribution, the wave field velocities, and their separation in the transfer region. Densitometric measurements horizontal and vertical to the axis gave values on the light emission process. Calculated radial distribution of the light emission established a maximum in the boundary zone. This maximum was two to three times larger than the intensity along the axis at a pressure of 10 or 15 torr. A uniform distribution was reached at a distance of several calibers more than 30 calibers behind the projectile. The photomultiplier and densitometric measurement methods made it possible to differentiate between the laminar region and the turbulent transfer regions. Transl. by G.G.

N69-36470# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AERODYNAMIC INVESTIGATION OF TURBULENT FLAME, DEVELOPING IN A FINITE COAXIAL WAKE JET

Sh. A. Ershin et al 28 Feb. 1969 23 p refs Transl. into ENGLISH from Teploenerg. i. Prikl. Teplofiz. (Alma-Ata), no. 4, 1967 p 228-239

(AD-688688; FTD-MT-24-451-68) Avail: CFSTI CSCL 21/2

A study was made to derive a method for determining the combustion of gases in finite coaxial wake jets. Since the theoretical operational aspect of the investigation is based on aerodynamic flame theory, preliminary investigations were made on the development of turbulent coaxial jets without combustion. Coaxial gas jets with different densities were discharged into a submerged air space from two concentric nozzles, 20 mm and 60 mm in diameter. The density difference was achieved by heating the internal jet to T(subscript 1) = 600, 900, and 1200 degree

K. The temperature of external jet was maintained constant (at room temperature). In the three series of tests with different density ratios, measurements were taken of the temperature variation, dynamic pressure, and values were calculated for the flow velocity. The complete aerodynamic pattern of a turbulent diffusion flame formed in the wake of coaxial jets at different nozzle diameter ratios. A decrease in the external jet diameter results in a substantial reduction of the flame length. Author (TAB)

N69-36482# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
PRELIMINARY THERMAL ANALYSIS OF THE DUTCH NATIONAL SATELLITE
W. H. de Leeuw 24 Oct. 1967 16 p ref
(RV-16) Avail: CFSTI

Temperature calculations were made for a simplified thermal model of the Dutch National Satellite. Two configurations were considered. One as presented in the K.A.N.S. proposal, and one with deployable solar panels. Author

N69-36484# RAND Corp., Santa Monica, Calif.
EQUIVALENCE RELATIONSHIPS BETWEEN DIFFUSE RADIATION FIELDS FOR FINITE SLABS BOUNDED BY A PERFECT SPECULAR REFLECTOR AND A PERFECT ABSORBER
J. L. Casti, H. H. Kagiwada, and R. E. Kalaba Apr. 1969 19 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-688821; RM-6020-PR) Avail: CFSTI CSCL 20/13

The paper demonstrates the use of computational methods in radiative transfer problems. It presents some simple algebraic relationships between source functions, as well as transmitted, reflected, and internal intensities, for a finite slab bounded by a perfect specular reflector and for the same slab bounded by a completely absorbing layer. Idealized models are used to derive simple analytical expressions. These expressions are evaluated numerically as a check on the diffusely reflected intensities. TAB

N69-36541# National Bureau of Standards, Washington, D.C. Electronic Technology Div.
THERMAL GRADIENT EFFECTS ON THIRTEEN FLUSH MOUNTED PRESSURE TRANSDUCERS
Leon Horn Aug. 1969 24 p refs
(NBS-TN-490) Avail: SOD $0.30

Thirteen different flush mounted pressure transducers were tested by creating a thermal gradient in them and recording the resultant zero shifts. Photographs of typical recordings show these general characteristics: a very rapid change in output reaching a peak in a second or less, a gradual shift which reaches a peak in a few seconds or more than a minute, and a shift in reading which remains as long as the gradient is maintained. Examples were found in which each of these were positive or negative. The magnitude in a few cases was small; in many there was a large fraction of its range, and in one case well in excess of the full scale range. Author

N69-36542# National Aerospace Lab., Tokyo (Japan).
THE COUPLING EFFECT OF RADIATIVE HEAT ON CONVECTIVE HEAT TRANSFER
Kenneth K. Yoshikawa Feb. 1969 8 p refs
(NAL-TR-173T) Avail: CFSTI

The effect of radiative heat on convective heat transfer with transpiration was examined in the stagnation region of axisymmetric bodies in hypersonic flight. The results, obtained from the linearized flow theory, show that convective heat in nonadiabatic flow can be approximated by the product of the convective heating ratio obtained from the adiabatic flow due to blowing, and the driving enthalpy ratio calculated from the inviscid nonadiabatic (radiation) flow. The validity of this relation is discussed and the results are compared with the numerical solutions of other references. Author

N69-36701*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
HEAT-TRANSFER CHARACTERISTICS OF A WATER-TO-CRYOGENIC-HYDROGEN HEAT EXCHANGER
Walter F. Weiland, Jr. and Donald W. Adams Washington Sep. 1969 32 p refs
(NASA-TN-D-5429) Avail: CFSTI CSCL 20M

Heat-transfer and pressure drop measurements were obtained for a heat exchanger suitable for regeneratively cooling the water in a water-moderated nuclear rocket reactor. The heat exchanger was of shell-and-tube design having parallel fluid flow with cryogenic hydrogen inside the tubes. The ranges of conditions investigated for steady-state operation are inlet water temperature from 600° to 660° R, inlet hydrogen temperature from 100° to 180° R, inlet fluid pressure of approximately 700 psia, and flow in the turbulent region. The investigation included conditions where ice is expected to be formed on the tubes. The results are compared with predicted values. The transient conditions investigated simulated expected conditions during reactor startup. Author

N69-36806*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
COMPARISON OF PREDICTED NOZZLE COLLANT SIDE HEAT TRANSFER AND FLUID FLOW WITH EXPERIMENTAL VALUES FROM PHOEBUS-2A NUCLEAR TESTS
Maynard F. Taylor Washington Sep. 1969 18 p refs
(NASA-TM-X-1881) Avail: CFSTI CSCL 20M

A recently reported method of predicting heat-transfer coefficients for the extreme conditions encountered in the cooling passages of regeneratively cooled nuclear rocket nozzles is used to predict pressures and temperatures at 34 stations in the Phoebus 2A nozzle. The predicted pressure and temperatures at the exit of the cooling passages are compared with the measured values of EP-IV nuclear tests and found to be in very good agreement. Incramental values of coolant temperatures and pressures, coolant passage wall temperatures, and heat flux to the coolant are calculated and shown. It is shown that a constant C_g of 0.026 yields values for coolant exit pressure and temperature that are in very good agreement with measured values. Author

N69-36813# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IS-DIAGRAM OF NORMAL HYDROGEN IN THE 16 TO 100 DEG K TEMPERATURE INTERVAL AND PRESSURES UP TO 500 kg/sq cm
S. A. Ulybin et al 26 Feb. 1969 14 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 13, No. 1, 1967 p 90-97
(AD-688784; FTD-HT-23-1050-68) Avail: CFSTI CSCL 20/13

In view of the extensive use of normal hydrogen in the engineering applications and the fact that the existing i-s (enthalpy-entropy) diagrams are limited to pressures on the order of 200 kg/cm (to the second power), the authors have calculated a preliminary i-s diagram for hydrogen by means of a simplified procedure. The authors have used a combined analytic and graphic procedure. To facilitate the analytic treatment of the experimental data, the entire range of parameters of state was divided into three regions: one covering states of gas with density below critical at all temperatures, the second for temperatures above critical and

densities above critical, and the third for temperatures below critical and densities above critical. The experimental data were drawn from published sources. Author (TAB)

N69-36910 Purdue Univ., Lafayette, Ind.
AN APPROXIMATE TREATMENT OF HEAT TRANSFER IN PLANE LAMINAR AND TURBULENT FLOWS OVER ARBITRARY SURFACES WITH ARBITRARY SURFACE INJECTION INCLUDING WALL CONDUCTION EFFECTS
David Alan Nealy (Ph.D. Thesis) 1968 218 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 69-2964

A unified approximate treatment of the general transpiration cooling problem is presented. Using the integral form of the boundary layer thermal energy equation, a method is developed which permits calculation of thermal boundary layer development under more general conditions than heretofore treated in the literature. The boundary layer calculation is coupled to the wall heat transfer problem through a coolant heat balance which includes the effects of axial conduction in the wall. The boundary layer and wall heat balance equations are solved simultaneously using straightforward numerical integration techniques. The general analysis is applicable to plane laminar and turbulent flows with arbitrary distributions of free stream velocity, injection rate, and surface temperature. The problem of internal wall heat transfer effectiveness is examined in some detail. New results are presented relative to definition of the internal wall heat transfer coefficients which are required to insure validity of conventional porous wall assumptions. The calculated results for laminar flows are in excellent agreement with existing analytical and experimental results. Dissert. Abstr.

N69-37004# ARO, Inc., Arnold Air Force Station, Tenn.
TEMPERATURE DEVELOPMENT IN THE ENTRANCE REGION OF A PARALLEL PLATE CHANNEL WITH WALL BLOWING Final Technical Report, Dec. 1967 – Apr. 1968
James R. Blanks AEDC May 1969 90 p refs
(Contract F40600-69-C-0001)
(AD-688210; AEDC-TR-69-58) Avail: CFSTI CSCL 20/4

The general mathematical problem of the thermal entrance region is formulated for a parallel plate channel by including the effects of viscous dissipation, axial conduction, and wall blowing. The associated eigenvalue problem is solved by the B. G. Galerkin method and the results are presented for constant wall temperature. It is shown that the particular method has distinct computational advantages over the classical form of solutions. The constant wall temperature case is investigated by employing the solutions of the eigenvalue problem, and it is concluded that the wall blowing parameter has considerable effect on the temperature development. The axial conduction term is also shown to have considerable effect on the temperature development for low values of Peclet number. Author (TAB)

N69-37149# Akademiya Nauk URSR, Kiev.
A TECHNIQUE OF STUDYING THERMAL PROPERTIES OF ROCKS AND CALCULATING HEATFLOW VALUES IN THE CRIMEA
T. S. Lebedev, B. Ya. Savenko, and D. V. Korniets *In its* Geophys. Commun., Issue 24 1968 p 61-72 refs In RUSSIAN; ENGLISH summary (See N69-37141 20-13)
Avail: CFSTI

The determination of thermophysical characteristics was carried out by two methods: (1) two temperature versus time points, and (2) linear instantaneous heat source. By the technique of two temperature versus time points, the thermal conductivity coefficient can be measured on core samples having a height of 1 to 2 *cm* and a diameter of 3 to 4 *cm*. The results furnished by the two methods agree to within 3%. Thermophysical characteristics of 200 core samples representing the main stratigraphic subdivisions were measured. The thermal conductivity of the Crimean sedimentary rocks varies from 2.8 to 7.0 · 10^{-3} *cal/cm*. sec. degree. A linear relationship was established between the thermal conductivity coefficient and density of rocks for different lithological varieties. A considerable influence upon the thermal conductivity of rocks is effected by the degree of their water saturation. As a function of water saturation, the thermal conductivity of clays can vary by more than a factor of 2, that of the high-density carbonate chalks only by 2 to 3% (within the precision limits). Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N69-36008*# National Aeronautics and Space Administration, Washington, D.C.
NASA SPECIAL PUBLICATIONS CURRENTLY AVAILABLE, FALL 1968
1969 50 p refs
Avail: NASA Scientific and Technical Information Division

A catalog of recent NASA publications is presented with abstracts. These special documents are grouped as: general series; technology utilization; handbooks, data compilations, charts and tables; histories and chronologies; management, evaluation, and analysis standards; and other reference works. A title index is also included. F.O.S.

N69-36012# Congress. House. Committee on Science and Astronautics
INSTITUTIONAL GRANTS BILL (H.R. 35)
Washington GPO 1969 360 p Hearings before Subcomm. on Sci., Res., and Develop., 91st Congr., 1st Sess., No. 2, 18-20 Feb., 25-27 Feb. 1969
Avail: Subcomm. on Sci., Res., and Develop.

A transcript of Congressional subcommittee hearings presents testimony concerning a bill to provide institutional grants for the support of science research and education in colleges and universities. Representatives of various educational institutions and organizations considered several aspects of the bill, including the role of science and science-related programs, the need for Federal support, differential allocation for master's and doctoral programs, reduction of other support to higher education, recommended methods of financing, and the significance of the establishment of a national institutional science council. L.B.H.

N69-36014# Congress. House. Committee on Science and Astronautics
PANEL ON SCIENCE AND TECHNOLOGY. TENTH METTING: SCIENCE AND TECHNOLOGY AND THE CITIES
Washington GPO 1969 308 p Proc. Before Comm. on Sci. and Astronaut., 91st Congr., 1st Sess., No. 1, 4-6 Feb. 1969
Avail: Comm. on Sci. and Astronaut.

A transcript is provided for the proceedings of a Congressional panel considering the relationship of science and technology to the problems of the cities. Emphasis is placed on the urban crisis itself, city planning, urban and interurban transportation, the socio-economic syndrome, and the application of science and

technology to urban problems. Testimony and papers presented by witnesses and panelists are included. Appendices provide biographies of witnesses and a copy of the Urban Detroit Area Report. L.B.H.

N69-36017# Congress. House. Committee on Appropriations.
INDEPENDENT OFFICES AND DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT APPROPRIATION BILL, 1970. PART 2: APPALACHIAN REGIONAL COMMISSION, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, NATIONAL SCIENCE FOUNDATION, SECURITIES AND EXCHANGE COMMISSION
Joe L. Evins Washington GPO 1969 1339 p Hearings before Subcomm. on Independent Offices and Dept. of Housing and Urban Develop., 91st Congr., 1st Sess., Mar.–Apr. 1969
Avail: Subcomm. on Independent Offices and Dept. of Housing and Urban Develop.

Testimony and discussion on fiscal year 1970 budget requirements presented by representative from the Appalachian Regional Commission, the National Aeronautics and Space Administration, the National Science Foundation, and the Securities and Exchange Commission are documented. The NASA presentation highlight highlights achievements in the Apollo manned lunar flight program, technology transfer benefits, prospects for military applications of NASA technology, and long term space exploration goals. Also considered are NASA construction facilities requests, personnel reductions, the Soviet space program status, supersonic transport development, NASA participation in the Tektite project, orbiting observatory measurements, Mariner 69 missions, and NERVA nuclear engine development. Comprehensive budgetary accounting data and briefing presentation materials are included. E.C.

N69-36191*# Techtran Corp., Glen Burnie, Md.
OPTIMIZATION OF A SATELLITE PROJECT
J. Schatz 1968 8 p Transl. into ENGLISH from Luftfahrttech. Raumfahrttech. (Germany), v. 14, no. 3, Mar. 1968 p 75–77
(Contract NAS5-14826)
(NASA-CR-105638) Avail: CFSTI CSCL 05A

In order to improve the efficiency of the development of a project, a project optimization group with specialized personnel from the fields of technology, finance, time-planning, and organization should be incorporated into the organization of the project program. This group judges the course of the project between the project management and the other specialized groups, evaluates possible variations, submits optimization proposals to the project management and directs these proposals when rejected to the business management. Author

N69-36273*# California Univ., Berkeley. Space Sciences Lab.
TECHNOLOGIES TRANSFER: A CONTEXT FOR POLICY CONSIDERATION
Todd R. La Porte Jun. 1969 27 p refs *Its* Internal Working Paper-104
(Grant NGL-05-003-012)
(NASA-CR-105646) Avail: CFSTI CSCL 05A

The application of technologies to urban development is studied, based on the assumption that scientific and technological progress are the primary determinants of change in cultures. Technology is defined as the application of scientific knowledge to the solution of social or economic problems. The relationship of science to political systems with the implementing technologies is summarized by use of a chart. These following problems are discussed: effects of using technology for social purposes, technology and the organization of public affairs, and technological transfer and the city. A set of general criteria for assessing technology as applied to urban and national problems are listed. F.O.S.

N69-36274*# California Univ., Berkeley. Space Sciences Lab.
ENABLING ACTIVITIES, PROFESSIONALS' EXPERIENCE AND RESOURCE RELATIONSHIPS: THE EFFICACY OF ENTREPRENEURIAL AND BOOTLEGGING ACTIVITIES
Todd R. La Porte Aug. 1969 30 p refs *Its* Internal Working Paper-105
(Grant NGL-05-003-012)
(NASA-CR-105645) Avail: CFSTI CSCL 05A

The role of the contemporary professional in organizational systems is considered from the aspect of the professional's decrease of influence in determining the manner in which his work is to be directed in the accomplishment of organizational demands for coordination, and control for achieving goals. The response of the management to the individual, influenced by funding and objectives, and the entrepreneurial activities of scientists to enable them to pursue the type of work they regard as rewarding are discussed. It is concluded that a decline in managerial control is occurring. F.O.S.

N69-36295# Congress. House. Committee on Science and Astronautics.
TECHNOLOGY: PROCESSES OF ASSESSMENT AND CHOICE
Jul. 1969 175 p refs NAS Report to the Comm. on Sci. and Astronaut., Jul. 1969
Avail: SOD: $0.75

The channelization of technological developments in directions that serve human needs is considered. Some grave and most urgent dangers posed by the applications of technology are listed as the specter of thermonuclear destruction; tensions of congested cities; pollution; the expanding arsenal of techniques for surveillance and manipulation of private thought and behavior; and the alienation of those who feel excluded from power. Existing processes of assessment and decision, the formulation of objectives, problems and pitfalls, and recommendations are discussed. It is concluded that mechanisms for technology assessment beyond those currently operating are clearly needed, and that the present organization of private and public assessment systems is too fragmented, uncoordinated, lacking in professionalism, and continuity to provide the required guidance. F.O.S.

N69-36314*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
TRANSACTIONS OF THE TENTH SCIENTIFIC CONFERENCE OF THE INSTITUTE OF HISTORY OF NATURAL SCIENCE AND TECHNOLOGY [TRUDY X NAUCHNOY KONFERENTSII ASPIRANTOV I MLADSHIKH NAUCHNYKH SOTRUDNIKOV INSTITUTA]
Yu. V. Biryukov et al Washington NASA Sep. 1969 66 p refs Transl. into ENGLISH from RUSSIAN Conf. Conf. held at Moscow, 1967
(Contract NASw-1692)
(NASA-TT-F-537) Avail: CFSTI CSCL 05A

CONTENTS:

1. THE ROLE OF S. P. KOROLEV IN THE DEVELOPMENT OF SOVIET ROCKET TECHNOLOGY DURING THE PERIOD OF ITS ORIGIN AND ESTABLISHMENT (1930–1941) Yu. V. Biryukov p 1–12 refs (See N69-36315 21-31)

2. THE PRINCIPLE CHARACTERISTICS AND DESIGN FEATURES OF R. GODDARD'S ROCKETS I. N. Bubnov p 13–23 refs (See N69-36316 21-28)

3. THE CONSTRUCTION OF AN ELECTRIC ROCKET ENGINE IN THE GAS DYNAMICS LABORATORY L. M. Aleksandrova p 24–30 refs (See N69-36317 21-28)

4. AN ANALYSIS OF THE DEVELOPMENT OF AVIATION MODELING IN THE 19th CENTURY Yu. I. Novokshonov p 31–39 refs (See N69-36318 21-02)

5. FORMATION OF THE PRINCIPAL TYPES OF GAS-TURBINE ENGINES Yu. S. Voronkov p 40-48 refs (See N69-36319 21-08)

6. THE DEVELOPMENT AND USE OF LIQUID-PROPELLANT ROCKET ENGINES IN EXPERIMENTAL AIRCRAFT IN THE USA (1944-1953) G. V. Skvortsov p 49-57 refs (See N69-36320 21-28)

7. THE HISTORY OF THE DEVELOPMENT OF THE PRINCIPLES FOR DETERMINING THE POSITION OF AN AIRCRAFT IN SPACE, BASED ON THE USE OF A PENDULUM P. N. Polozhin p 58-62 refs (See N69-36321 21-14)

N69-36442*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

A COMPARATIVE ANALYSIS OF THE PROFESSIONAL'S OCCUPATIONAL ENVIRONMENT AT THE MANNED SPACECRAFT CENTER

Richard A. Hamilton (San Diego State Coll.) Jan. 1969 59 p refs

(NASA-TM-X-61808; MSC-BM-MR-69-2) Avail: CFSTI CSCL 05A

This study was a comparative analysis of the work environments of nonsupervisory Aerospace Technologists at the Manned Spacecraft Center in Houston, Texas. Specifically, it focused on the attitudes or perceptions that nonsupervisory AST's have toward their organization and position in the following Directorates: Engineering and Development; Flight Operations; Science and Applications; and Flight Crew Operations. The report considers the limitations of cause-effect relationships between two variables and cautions against "organizational scientism." Building upon the results from computer analysis, the study's second stage explored the possibility of organizational payoffs associated with job ambiguity. The results indicated that a certain degree of job ambiguity was functional and interrelated with the nature of the ASTs' work group environment. However, the interviewees with high ambiguity scores generally reported detrimental effects associated with a high degree of uncertainty concerning their organizational position.

Author

N69-36743# Joint Publications Research Service, Washington, D.C.

INFORMATION AS REFLECTION

L. Ye. Anisimova 21 Aug. 1968 13 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), Jun. 1968 p 84-92

(JPRS-46241) Avail: CFSTI

A discussion of the theory of information is presented. Information as it relates to modern science is discussed from a philosophical point of view. Emphasis is placed on the numerical theory of information as formulated by Shannon and others. Formulas, encoding, and decoding arrangements are also presented for computerized information systems.

J.M.C.

N69-36917*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

A STUDY OF THE RELATIONSHIP OF CERTAIN PROJECT TEAM AND CONTRACT CHARACTERISTICS TO THE PERFORMANCE OF R AND D CONTRACTS

Raymond Lee Read (Ph.D. Thesis - Florida State Univ.) Jan. 1969 111 p refs Sponsored in part by Tex. Univ.

(NASA-TM-X-61809; MSC-BE-MR-69-3) Copyright. Avail: CFSTI CSCL 05A

Objective criteria based on contract and project team characteristics which bear a relationship to contract performance were investigated by studying contracts between $100,000 and one million dollars. Hypotheses were formulated which stated the relationship between contract and project criteria and performance. It is concluded: (1) There is a relationship between the average number of degrees per man and the contract performance. (2) There is no relationship between the experience per man on a project team and the performance. (3) There is no relationship between contract performance and the fact that a contract is compensated on either a cost-plus-a-fixed-fee, or fixed-price basis.

F.O.S.

N69-36934# Congress. House. Committee on Science and Astronautics.

SCIENCE, TECHNOLOGY, AND PUBLIC POLICY DURING THE NINETIETH CONGRESS, FIRST AND SECOND SESSIONS, 1967-1968

Washington GPO 1969 352 p refs Presented to the Comm. on Sci. and Astronaut. 91st Congr., 1st Sess., Serial D, Jul. 1969

Avail: Subcomm. on Sci., Res., and Develop.

This report covers public policy for science and technology during the 90th Congress. Emphasis is placed on the governing applications of science and technology. Included are chapters on research, development, and national goals; fostering applications of science and technology; national resources, organization and administration, and federal funds for science and technology; and science and technology in foreign affairs. Attention also is given to advice, decisions, and legislation which change present policies.

Author

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